Critical Success Factors for Implementing ISO 9001 in UK Construction Projects

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Abstract

Numerous challenges face construction companies in today's competitive market, including the complex and contractually varied relationships of those involved; the nature of construction projects producing unique, non-repetitive outcomes; the lack of standardisation; the impact of changes to the project design; and contractual disputes that arise. These challenges lead to late delivery, increased costs and negative impacts on quality, thus eroding client satisfaction and the ability of the project to meet the client's needs and expectations. Therefore, there is strong rationale not only to employ a quality management system (QMS) such as ISO 9001 to create a systematic process for ensuing quality, but also to investigate the perceptions of those who implement such systems in order to gain insights into the critical success factors for implementation and successful project outcomes.

This study explored the ISO 9001 QMS in the UK construction project context, investigating those critical success factors that can lead to its successful implementation. First, a literature review was carried out to provide the theoretical grounding for the investigation. The critical success factors and factor components that emerged then formed the basis of a quality management survey, which was completed by UK-based project managers to ascertain those factors deemed vital for the UK construction context. The data was collected and statistically evaluated through SPSS, with the compare means, Kendall's W, Kruskal–Wallis, and Spearman correlation coefficient tests then applied. The results were validated through semi-structured interviews with UK-based project managers in order to explore, corroborate and extend the results from the quality management survey. Content analysis was applied to the qualitative interview data, leading to a greater depth of understanding of the questionnaire results, the rejection of some items, and the inclusion of others.

The final outcome of this study comprises 7 critical success factors (i.e. change management, client focus, engagement of people, leadership, the process approach, relationship management, and continuous improvement) and 76 associated factor components found to be vital to the effective implementation of ISO 9001 and successful project outcomes in UK construction projects. Six of these critical success factors are currently established as Quality Management Principles (QMPs) in ISO 9001:2015, thus confirming their continued inclusion, with change management representing a new candidate for inclusion as a QMP. Moreover, of the 3 critical success factors rejected by this study (i.e. evidence-based decision-making, non-standardisation, and skills and training), the rejection of evidence-based decision-making is a surprising finding, given its current inclusion as a QMP in ISO 9001:2015. Therefore, this study encourages further examination of the justification for its inclusion as a critical success factor, given the findings of this research.

The researcher hopes that the findings emerging from this study can shed further light on ISO 9001 quality management implementation in the UK context, offering guidance for quality management specialists in the context of construction projects. Furthermore, it is believed that embracing the findings will help to reduce delays while enhancing the projects' overall efficiency, the likelihood of attaining quality outcomes, and most importantly, client satisfaction. In terms of the quality management literature, the findings offer rich insight into project managers' implementation of ISO 9001 in UK construction projects, while offering valuable input for its development, and the potential for the research findings to be harnessed by other QMSs.

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Finally, I extend my deep thanks to my parents for believing in me and my ability to complete this PhD study in the UK. Without your belief and sacrifices, my PhD journey would not have been possible.

Dedication

To my beloved wife and parents

Declaration

This thesis is presented as an original contribution based on PhD research at University of Salford, Salford, United Kingdom, and has not been previously submitted to meet the requirements for an award at any higher education institution under my name or that of any other individuals. To the best of my knowledge and belief, the thesis contains no materials previously published or written by another person, except where due reference is made.

Signature: …………………………………………………………

Date: ………………………………………………………………

List of Publications

The following papers have been presented, submitted for publication, or published to date:

Aburas, M. & Lee, A. (2019). A Literature Review Exploring the Critical Success Factors for the Effective Implementation of the ISO 9001 Quality Management System in Construction Projects. 14th International Postgraduate Research Conference in The Built Environment (IPGRC): Contemporary and Future Directions in the Built Environment 16–17 December 2019. The University of Salford, UK.

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List of Abbreviations

APPG	All Party Parliamentary Group
BIM	Building Information Modelling
BPM	Business Process Management
BPR	Business Process Reengineering
CCS	Confederation of Construction Specialists
CIOB	Chartered Institute of Building
CONQUAS	Construction Quality Assessment System
DMAIC	Define, Measure, Analyse, Improve, and Control
EFQM	European Foundation for Quality Management
HACCP	Hazard Analysis and Critical Control Points
ISO	International Organization for Standardization
KPI	Key Performance Indicator
LSS	Lean Six Sigma
PDCA	Plan, Do, Check, Act
PRINCE2	Projects IN Controlled Environments2
PMBOK	Project Management Book of Knowledge
QMP	Quality Management Principle
QMS	Quality Management System
RIBA	Royal Institution of British Architects
RICS	Royal Institute of Charted Surveyors

SMEs	Small and Medium-sized Enterprises
SPSS	Statistical Package for the Social Sciences
TQM	Total Quality Management
UK	United Kingdom
US	United States of America

Table of Contents

Abstract ii

Acknowledgments iii

Dedication iv

Declaration v

List of Publications vi

List of Abbreviations vii

List of Tables xvi

List of Figures xviii

Chapter 1 Introduction 1

1.1 Research background 2

1.2 Problem statement 5

1.3 Research question 7

1.4 Aim and objectives 7

1.5 Scope of the research 8

1.6 The research design 9

1.7 Thesis structure 12

1.8 Conclusion 13

Chapter 2 UK Construction 15

2.1 Introduction 16

2.2 Characteristics of construction projects 16

2.3 UK construction industry 19

2.4 UK construction projects 21

2.4.1 Project delivery 24

2.4.2 Parties 29
2.4.3 Project management 32
2.4.4 Project delivery to other sectors 34
2.5 Construction project challenges 36
2.6 Conclusion 39
Chapter 3 Quality Management and ISO 9001 41
3.1 Introduction 42
3.2 Quality in construction projects 42
3.3 Quality management system overview 45
3.3.1 The history and development of QMSs 47
3.3.1.1 Total Quality Management 53
3.3.1.2 Lean Management and Six Sigma 55
3.3.1.3 European Foundation for Quality Management 58
3.3.1.4 Building Information Modelling 58
3.3.1.5 Business Process Management 59
3.3.1.6 Business Process Reengineering 60
3.3.1.7 PMBOK and PRINCE2 60
3.4 The ISO QMS 61
3.4.1 The ISO 9000 family of standards 64
3.4.2 The ISO 9001 standard 66
3.4.2.1 Client focus 69
3.4.2.2 Leadership 69
3.4.2.3 Engagement of people 70
3.4.2.4 Process approach 71
3.4.2.5 Improvement 72
3.4.2.6 Evidence-based decision-making 73
3.4.2.7 Relationship management 73
3.5 ISO 9001:2008 vs ISO 9001:2015 74

3.6 The benefits of using ISO 9001 77
3.6.1 ISO and procurement 80
3.7 The importance of the ISO 9001 QMS in construction projects 82
3.8 The challenges hindering effective implementation of the ISO 9001 QMS in construction projects 85
3.9 Critical success factors to support effective implementation of the ISO 9001 QMS in construction projects 96
3.10 Conclusion 112
Chapter 4 Research Methodology 113
4.1 Introduction 114
4.2 Research methodology overview 114
4.3 Research philosophy 115
4.3.1 Ontology 118
4.3.2 Epistemology 119
4.3.3 Axiology 120
4.3.4 The philosophical position of the research 121
4.4 Research approach 122
4.4.1 Justification for the selected research approach 124
4.5 Research choice 126
4.5.1 Quantitative (mono) method 126
4.5.2 Qualitative (mono) method 126
4.5.3 Triangulation (mixed) method 128
4.5.4 Justification for the research choice 129
4.6 Research strategy 130
4.6.1 Survey 131
4.6.2 Grounded theory 132

4.6.3 Ethnographic research 132
4.6.4 Archival research 133
4.6.5 Case study 134
4.6.6 Justification for the survey as the primary research strategy 135
4.7 Time horizon 136
4.8 Research techniques 136
4.8.1 Literature review 137
4.8.2 Questionnaires 137
4.8.3 Interviews 138
4.8.4 Data sampling 140
4.8.4.1 Probability sampling 141
4.8.4.2 Non-probability sampling 143
4.8.5 Data analysis 143
4.8.5.1 Quantitative data analysis 144
4.8.6 Validity and reliability 145
4.9 Conclusion 146
Chapter 5 The ISO 9001 Quality Management Survey 147
5.1 Introduction 148
5.2 Questionnaire design 148
5.2.1 Questionnaire rating scale 150
5.3 Ethical issues 151
5.4 Questionnaire pilot test 151
5.5 Reliability test 152
5.6 The results 152
5.6.1 Participants' general information (part one) 153
5.6.2 Breakdown of the critical success factors (part two) 158

5.6.2.1 Breakdown of the change management critical success factor 159
5.6.2.2 Breakdown of the evidence-based decision-making critical success factor 163
5.6.2.3 Breakdown of the client focus critical success factor 169
5.6.2.4 Breakdown of the reduce the impact of non-standardisation critical success factor 174
5.6.2.5 Breakdown of the engage the project team critical success factor 178
5.6.2.6 Breakdown of the leadership critical success factor 184
5.6.2.7 Breakdown of the process approach critical success factor 191
5.6.2.8 Breakdown of the manage relationships with stakeholders' critical success factor 197
5.6.2.9 Breakdown of team members' skills and training critical success factor 202
5.6.2.10 Breakdown of the continuous improvement critical success factor 207
5.7 The compare means test 214
5.8 The Kendall's W test 216
5.9 The Kruskal–Wallis test 217
5.10 The Spearman correlation coefficient test 218
5.11 Critical success factors to support effective implementation of the ISO 9001 QMS in UK construction projects based on the quality management survey and the literature review 220
5.12 Conclusion 229
Chapter 6 The Validation Stage 231
6.1 Introduction 232
6.2 Interview design 232
6.2.1 Interview objective 233
6.2.2 Interview questions 233
6.2.3 Interview reliability and validity 234
6.2.4 Selection of interviewees 235
6.2.5 Interview process 236
6.2.6 Ethics 237

6.2.7 Interview analysis 237

6.3 Discussion of the findings..240

6.3.1 Change management 241

6.3.2 Evidence-based decision-making..243

6.3.3 Client focus..244

6.3.4 Reduce the impact of non-standardisation..245

6.3.5 Engagement of people 246

6.3.6 Leadership 248

6.3.7 Process approach..249

6.3.8 Relationship management..251

6.3.9 Skills and training 252

6.3.10 Continuous improvement 254

6.4 Results of the validation interview analysis..255

6.5 Conclusion 265

Chapter 7 Conclusion 266

7.1 Introduction..267

7.2 Synthesis of the research objectives 268

7.2.1 Objective one: conduct a review of the literature in the field to gain a theoretical understanding of the UK construction industry, UK construction projects and the ISO 9001 QMS...268

7.2.2 Objective two: carry out a review of the literature in the field to determine the barriers to the effective implementation of the ISO 9001 QMS in construction projects 269

7.2.3 Objective three: develop critical success factors for effective implementation of the ISO 9001 QMS in UK construction projects...270

7.2.4 Objective four: validate the developed critical success factors for effective ISO 9001 QMS implementation in UK construction projects 271

7.3 Research findings 272
7.3.1 Change management 272
7.3.2 Evidence-based decision-making..273
7.3.3 Client focus..273
7.3.4 Non-standardisation 274
7.3.5 Engagement of people 275
7.3.6 Leadership 275
7.3.7 Process approach..276
7.3.8 Relationship management..277
7.3.9 Skills and training 277
7.3.10 Continuous improvement 278
7.4 Conclusions of the study..278
7.5 Research methodology critique 281
7.6 Research limitations 282
7.7 Contribution to knowledge..283
7.8 Research novelty 285
7.9 Research recommendations..285
7.10 Final words..286
References 288
Appendices 321
Appendix 1: The Quality Management Survey..322
Appendix 2: Cover Letter for the Quality Management Survey 331
Appendix 3: Ethical Approval for the Study..332
Appendix 4: The Validation Interview Questions..333
Appendix 5: Information Sheet for the Validation Interviewees 336

List of Tables

Table 2.1: Project delivery systems 25
Table 3.1: The QMS structure and clauses provided by the 2008 and 2015 standards 76
Table 3.2: The most common internal and external benefits of implementing ISO 9001 80
Table 3.3: The most common barriers hindering effective ISO 9001 QMS implementation 92
Table 3.4: The critical success factors for effective implementation of the ISO 9001 QMS 104
Table 4.1: Deduction, induction and abduction 124
Table 4.2: Quantitative vs qualitative research 128
Table 5.1: The 5-point Likert scale's intervals of level 150
Table 5.2: Reliability statistics 152
Table 5.3: Organisation has ISO 9001 QMS certification 153
Table 5.4: The respondents' comments on why ISO 9001 certification was not held 155
Table 5.5: Application of the ISO 9001 QMS standard in construction projects 155
Table 5.6: Why the ISO 9001 standard was not applied in construction projects 157
Table 5.7: An alternative QMS adopted to manage quality 157
Table 5.8: Application of alternative quality standards in projects 158
Table 5.9: The importance of the change management components 160
Table 5.10: Additional change management components identified 162
Table 5.11: The importance of the evidence-based decision-making components 164
Table 5.12: Additional evidence-based decision-making components identified 168
Table 5.13: The importance of the client focus components 170
Table 5.14: Additional client focus components identified 173
Table 5.15: The importance of reducing the impact of non-standardisation components 175
Table 5.16: Additional non-standardisation components identified 177
Table 5.17: The importance of the engage the project team components 179
Table 5.18: Additional engage the project team components identified 182
Table 5.19: The importance of the construction project leadership components 185
Table 5.20: Additional construction project leadership components identified 189
Table 5.21: The importance of the process approach components 191

Table 5.22: Additional process approach components identified 195
Table 5.23: The importance of the relationship management components 197
Table 5.24: Additional managing relationships with stakeholders' components identified 201
Table 5.25: The importance of the skills and training components 203
Table 5.26: Additional skills and training components identified 206
Table 5.27: The importance of the continuous improvement components 208
Table 5.28: Additional continuous improvement components identified 212
Table 5.29: The compare means test results 216
Table 5.30: The Kendall's W test 217
Table 5.31: The Kruskal–Wallis test 218
Table 5.32: The Spearman correlation coefficient test 219
Table 5.33 Summary of the Likert scale analysis 220
Table 5.34: Determining analysis of the critical success factors to support implementation 222
Table 6.1: Profiles of the interview participants 236
Table 6.2: Validated factor components: change management 243
Table 6.3: Validated factor components: client focus 245
Table 6.4: Validated factor components: engagement with people 247
Table 6.5: Validated factor components: leadership 249
Table 6.6: Validated factor components: the process approach 251
Table 6.7: Validated factor components: relationship management 252
Table 6.8: Validated factor components: continuous improvement 255
Table 6.9: The final critical success factors to support effective implementation of ISO 9001 ..260
Table 7.1: Provisional findings after the quality management survey data analysis 279
Table 7.2: Validated findings of the study 280

List of Figures

Figure 1.1: Flow diagram of the thesis 11
Figure 2.1: Project process groups........ 19
Figure 2.2: New orders to the UK construction sector from 1958 to 2018........ 20
Figure 2.3: European production in construction: December 2020........ 20
Figure 2.4: RIBA Plan of Work 2020........ 27
Figure 2.5: Construction project stakeholders........ 29
Figure 2.6: Skills' requirement for the range of project management roles 33
Figure 3.1: The quality management of projects........ 43
Figure 3.2: The historical evolution of quality methods 53
Figure 3.3: The LSS model merged with the DMAIC method 57
Figure 3.4: A selection of ISO standards 63
Figure 3.5: The ISO 9000 family embedded in the process approach........ 65
Figure 3.6: Defining the ISO 9000 series and evolution........ 66
Figure 3.7: The evolution of ISO 9001 68
Figure 3.8: Overview of the ISO 9001:2015 QMS QMPs........ 74
Figure 3.9: The benefits of using ISO 9001 78
Figure 3.10: The PMI Talent Triangle 109
Figure 3.11: The critical success factors for effective implementation of the ISO 9001 QMS ...111
Figure 4.1: Nested research design 115
Figure 4.2: The Research Onion Model........117
Figure 4.3: The philosophical position in this research 122
Figure 4.4: The process of deduction 125
Figure 4.5: The methodological choice 129
Figure 5.1: Organisational application of ISO 9001 QMS certification 154
Figure 5.2: Organisational application of the ISO 9001 QMS in UK construction projects 156
Figure 5.3: The importance of the change management critical success factor........160
Figure 5.4: The importance of the decision-making critical success factor........165
Figure 5.5: The importance of the client focus critical success factor........171
Figure 5.6: The importance of the reduce impact of non-standardisation critical success factor 176

Figure 5.7: The importance of the engage the project team critical success factor.....................180
Figure 5.8: The importance of the construction project leadership critical success factor..........186
Figure 5.9: The importance of the process approach critical success factor...............................192
Figure 5.10: The importance of the relationship management critical success factor.................198
Figure 5.11: The importance of the skills and training critical success factor............................204
Figure 5.12: The importance of the continuous improvement critical success factor.................209
Figure 6.1: Example of the coding process in the leadership theme 239
Figure 6.2: The data coding process 240

Chapter 1

Introduction

1.1 Research background

Construction is an important contributor to growth, adding £117 billion to the UK economy in 2018, as well as 2.4 million jobs in the second quarter of 2019, representing 6.6% of all UK employment (Rhodes, 2019). The construction sector's output has seen steady growth in recent years, being 12% higher in the third quarter of 2019 than in the first quarter of 2017 (Rhodes, 2019). The UK construction industry targets enhanced efficiency, productivity, sustainability, quality and the value of infrastructure, while lowering lifecycle costs and lead times through improved communication and increased collaboration with construction project stakeholders (Arayici et al., 2012), leading to unique and complex challenges in relation to management, communication (Arditi and Gunaydin, 1998) and contractual relationships (Pratt, 1995). In 2013, the UK government published a vision for the development of the construction industry in its *Construction 2025* report, where efficiency targets were set for a 33% reduction in the cost of the construction, as well as a 50% reduction in project delivery times and a 50% reduction in greenhouse gas emissions (HM Government, 2013). Client satisfaction is closely tied to retention, which is essential for organisations to survive and prosper (Omonori and Lawal, 2014; Luburić, 2015). The relationship between contractors and architects remains somewhat adversarial (Proverbs et al., 2018), despite Enshassi et al. (2009) and Manders and de Vries (2012) asserting that the project management teams must ensure stakeholders are identified, and their expectations and requirements understood at the outset. According to Vrijhoef and Koskela (2005), who published a critical review of construction as a project-based industry, the construction industry is project-based and characterised by complexity in terms of the projects undertaken, whereby a myriad of parties must cooperate in order to ensure the final product meets the required quality.

By their nature, construction projects are fragmented, which represents a key factor affecting the performance and productivity (Rybski et al., 2017), while stakeholders can be located remotely either nationally or internationally (Hadavi and Krizek, 1994), with decision-making processes that are centralised and poor delegation of authority to staff being the primary cause of decision-making delays in UK construction projects (Sidawi, 2013), despite the decision-making process being key to ensuring a successful construction project (Scherer and Schapke, 2011). Thus, a key factor impacting on the project's overall cost and completion time is quality, which significantly impacts on the overall successful of the project outcome (Heras et al., 2011).

Numerous approaches and instruments are available that can be employed by construction companies to preserve or enhance the quality of a project while reducing the cost and duration, with ISO 9001 representing the most important instrument (Criado and Calvo-Mora, 2009). The International Organization for Standardization (ISO) launched the initial ISO 9001 version in 1987, with a view to enhancing client satisfaction and increasing quality in the manufacturing sector. The ISO 9001 standard has been accepted worldwide, and subsequently was expanded to other domains, including the construction industry over the past two decades, as a policy for ensuring quality (Neyestani and Juanzon, 2017a). It is important to note that ISO 9001 is a process-based standard that is employed to control processes and management with the aim of improving project performance and ensuring project quality (Medić et al., 2016; Sickinger-Nagorni and Schwanke, 2016; Anttila and Jussila, 2017). In their quantitative questionnaire survey completed by 126 quality managers of Spanish construction companies, Prado-Roman et al. (2018) found that ISO 9001 certification leads to both internal benefits (e.g. improvement in the operations and organisation) and external benefits (e.g. client management and competitivity); however, this research was conducted in the Spanish construction industry context and only considered perceptions of the benefits or effects of implementation, rather than exploring what specific factors were critical to achieving these benefits when applying the QMS in construction projects.

The word *quality* can either be utilised grammatically as a noun or an adjective, and in the lens of this thesis, the emphasis is placed on the noun. People may hold different perceptions of the meaning of quality: some may consider that it implies a state of perfection, that a procedure or set of rules have been strictly adhered to, or that high quality signifies an expensive, high-class outcome; while others may imagine strict systems, inspectors, and that higher production will result in lower quality (Hoyle, 2018). The Macmillan (2007) dictionary describes the noun *quality* as explaining the degree of goodness or badness of something, or referring to high standards. The Oxford English Dictionary (2019) states that *quality* can be used as a noun to describe the standard of something in terms of other similar things, and its level of excellence. Mukherjee (2019) reported that the notion of quality is often framed in terms of (i) raw materials, (ii) processes, (iii) processed materials, (iv) products, and (v) services. He continued by asserting that quality is also viewed as the extent of excellence in (i) a material, product or process; (ii) a delivered or procured service; (iii) a work environment; or (iv) a collective or individual performance (Mukherjee, 2019). In the construction project context, the definition of quality can be viewed as meeting or exceeding the client's requirements including the contract specifications, completion on time, meeting the budget and avoiding disputes (Ning et al., 2011; Jraisat et al., 2016; Proverbs et al., 2018). In their study focusing on continuous improvement and the involvement of clients in the purchasing process to enhance the quality of the construction project, Janipha et al. (2014) conducted a survey of Malaysian construction companies, where they found that the clients' involvement in the purchase of construction materials both increased the likelihood of the final project meeting their requirements and led to cost savings, thus enhancing the potential for the overall success of the project in terms of client satisfaction. Quality could be said to be subjective, with each person having their own perception of what the term actually means. The ISO's description of quality as being "the totality of characteristics of an entity that bears on its ability to satisfy stated or implied needs" (Rumane, 2018, p.7), the "degree to which a set of inherent characteristics meet requirements" (Mukherjee, 2019, p.10), and "the degree of excellence" (Padhy, 2013, p.119) offer perhaps the most concrete definitions, with Rumane (2018) underscoring that the definitions of quality for construction projects differ from those applied to the manufacturing and services sectors, as the former results in unique outcomes as opposed to involving repetitive processes. Quality is not the state of perfection, as quality has a strong relationship to cost, the market and technology (Mukherjee, 2019). Rumane (2018) described quality as fulfilling the specified requirements, being fit for purpose, and meeting the client's needs. Moreover, quality improvements need to be taken into account alongside the value added, and the additional cost required to achieve this added value (Mukherjee, 2019). Quality can be defined through (i) the transcendent approach, and striving for the highest standards; (ii) the product-based approach, where the focus is placed on certain characteristics that suggest higher quality; (iii) the user-based approach, where the user decides on the degree of quality and whether it is fit for purpose; (iv) the manufacturing-based approach, where requirements are conformed to; and (v) the value-based approach, whereby quality is the degree of excellence achieved within the confines of acceptable cost (Mukherjee, 2019). In the case of construction projects, quality applies not only to the equipment and products utilised during the construction process, but also to the overall approach to management, with the quality of the construction depending primarily on the control, which is the contractor's main responsibility (Rumane, 2013).

1.2 Problem statement

Globalisation and competitive pressure are key drivers forcing construction companies towards the improvement of their practices, where significant human and material resources, time and finances are wasted annually in construction projects due to inefficiencies or management procedures of poor quality (Polat et al., 2011). In the UK, construction projects are challenged by a number of issues including: insufficiently skilled workers, poor profitability, and limited investment in terms of research and development (McDonnell, 2018); thus, training employees with broadly applicable skills and knowledge is vital (Chua et al., 1999; Adetunji et al., 2003). Additionally, Proverbs et al. (2018) claimed that the industry's clients often express dissatisfaction with the service provision as well as the end product's quality, where the researchers conducted a literature review of the issues facing UK construction projects and then carried out a survey with 49 managing directors of UK construction companies listed in the Chartered Institute of Building’s (CIOB) Directory Handbook, which confirmed issues that included the poor image of the industry, quality concerns resulting from unprofessionalism, design changes during the project, and the competitive tendering process, amongst others. In terms of standardisation, clients may have standard processes, while companies and suppliers' manufacturers can standardise components through standardised procedures (Egan, 1998; Gibb and Isack, 2001; Münstermann and Weitzel, 2008), with effective leadership essential due to the characteristics that prevail in the construction process (Toor and Ofori, 2008; Sickinger-Nagorni and Schwanke, 2016), and particularly due to the impact of non-standardisation (Strange and Vaughan, 1993) and the diversity (Bawane, 2017) of each project. In his *Rethinking Construction* report, Egan (1998) recommended that the construction industry learn from others such as the automotive industry, whereby designers, suppliers and sub-contractors should become involved to ensure the greater utilisation of standardised components, which would not necessarily lead to monotony in terms of the design. This issue was again highlighted in the UK Government’s *Construction Strategy* (Cabinet Office, 2011), which cited the need to address inefficiency and waste in the industry, which is compounded by the paucity of standardisation.

In their research exploring the status of quality management in large ISO 9001-certified construction companies based in the UK, Marasini and Quinnell (2010) found that site managers received insufficient training in terms of the skills needed to carry out quality management; consequently, they relied heavily on their experience and had limited understanding of techniques available to enhance the quality of their projects. The limited awareness of the ISO 9001 QMS's benefits in project management was the most significant problem identified by Ali and Rahmat (2010). Moreover, in their review of construction project success discussed in eleven leading journals, Ramlee et al. (2016) found quality to be a key pillar of project success, alongside the management, cost and delivery of the project. Construction projects typically encounter many challenges such as defective workmanship, delays, and excessive costs, while projects' processes are vulnerable to climatic conditions and variables that cannot be controlled (Hadavi and Krizek, 1994). Circumstances often complicate construction projects, whereby the involved parties must draw up a shortlist of possible alternatives and then select the best solution as a compromise between the various, often conflicting objectives, in order to avoid significant impacts on the completion time and cost (Lee et al., 2005; Hao et al., 2008; Karimidorabati et al., 2016). The complexity has increased due to the intricate nature of the construction process and the myriad of parties involved that include the client, architects, consultants, contractors, sub-contractors, suppliers and the regulator (Neyestani and Juanzon, 2016), who represent a source of considerable uncertainty in the construction project context (Skipper and Bell, 2006; Atkin and Skitmore, 2008). Thus, construction projects' need for a QMS through the linking of interconnected processes to enable the delivery of the organisational objectives is pertinent (Sitnikov and Bocean, 2015), which allows the system to be structured to facilitate achieving the organisation's goals effectively and efficiently, while highlighting the responsibilities and roles required to achieve these (Fonseca and Domingues, 2017a).

As reported by Rumane (2016), the findings that emerged from a construction quality survey conducted by the International Federation of Consulting Engineers (FIDIC) underscored the global extent of the issue of failure in terms of construction quality, and thus reinforcing the need for QMSs in construction. Construction projects in particular have experienced mixed results from the implementation of QMSs, and they continue to produce waste and failed projects that result from weak quality management. From a UK perspective, the *More Homes, Fewer Complaints* (All Party Parliamentary Group, 2016) report presented that the majority of new home buyers wanted to see an improvement in the quality of the homes being built, while the National House Building Council planned to introduce Construction Quality Audits to address this concern. Given the potential benefits of successful QMS implementation, there is a surprising paucity of research into the provision of guidance for construction projects aiming to adopt and improve their quality systems (Bawane, 2017).

With the construction industry thus characterised by the complexity of the invariably unique projects, with a diverse range of parties involved and pressures to complete the project on time and within the budget, while achieving a degree of quality that is satisfactory to the client, there is a strong rationale for the implementation of a QMS such as ISO 9001 to enhance the project performance and ensure project quality, particularly due to the issues that UK construction industry faces in terms of delays, projects running over budget and quality concerns. Critical success factors offer the opportunity to improve the effectiveness and efficiency of a project (Kumara Silva et al., 2016), with Ismyrlis et al. (2015) asserting their significant importance for QMSs since they represent the tools necessary to achieve the system's aim. The CIOB's (2019) *Code of Quality Management* states that in an industry characterised by unique project outcomes with limited standardisation and considerable off-site assembly, ensuring an effective quality management plan is vital. Therefore, with a QMS found to be an essential component of ensuring quality success, and critical success factors known to be valuable tools to enhance the effectiveness, this study seeks to investigate the critical success factors for the implementation of the ISO 9001 QMS to ensure successful project outcomes.

1.3 Research question

With the importance of the ISO 9001 QMS established above, alongside the quality issues that UK construction projects face and the paucity of research into seeking opportunities to enhance the implementation of the QMS in construction projects, this study proposes the following research question:

What are the critical success factors for the implementation of the ISO 9001 QMS to achieve successful outcomes in UK construction projects?

1.4 Aim and objectives

This study aims to investigate the critical success factors for effective ISO 9001 QMS implementation in UK construction projects through the perceptions of UK construction project managers.

In order to achieve the research aim, the following objectives are established in this study:

- Conduct a review of the literature in the field to gain a theoretical understanding of the UK construction industry, UK construction projects and the ISO 9001 QMS.
- Carry out a review of the literature in the field to determine the barriers to the effective implementation of the ISO 9001 QMS in construction projects.
- Develop critical success factors for effective implementation of the ISO 9001 QMS in UK construction projects.
- Validate the developed critical success factors for effective ISO 9001 QMS implementation in UK construction projects.

1.5 Scope of the research

There is a need to define the scope of the research in order establish the focus of the study and limitations for what will be investigated. Such definition will also help the researcher to target his resources more effectively in this investigation. The scope is based on a number of criteria, established as follows:

- In terms of the context of the research, this study places its focus on UK construction companies that utilise the ISO 9001 QMS in their construction projects. Natarajan (2017) described the QMS as a documented procedure to ensure that an organisation's processes meet the needs and expectations of its clients, with ISO 9001 applied broadly by many organisations worldwide and providing a quality assurance model for installation, design, development, production and servicing (Rumane, 2018). The focus on construction projects is due to the researcher's personal interest and background of expertise, while the emphasis on UK construction projects is due to the researcher being located in the UK during his PhD study, and thus being well placed to access practitioners in the field.
- Regarding the participants, this study requires those with insight into the implementation of the ISO 9001 QMS in UK construction projects, and therefore project managers employed in UK construction companies comprise the participants from which the primary data is gathered.

- In terms of the area of investigation, this research focuses its lens on exploring the critical success factors necessary for the successful implementation of the ISO 9001 QMS in UK construction projects, since the identification of such critical success factors can enhance positive project outcomes (Tsiga, et al., 2016), with Bullen and Rockart (1981) describing critical success factors as those key areas where positive results are vital for managers to achieve their objectives.

1.6 The research design

The following stages outline the main phases of the research design adopted in this study:

Stage 1) In the initial exploration and formulation stage, the aim and objectives of the study are formed by exploring the literature related to the UK construction industry, UK construction projects, quality management, and ISO 9001. Then, the research methodology-related literature is examined to establish a foundation for selecting the most appropriate research method to achieve the aim and objectives of the investigation.

Stage 2) In the investigation stage, the primary data is collected. An online survey is administered to 1,000 project managers in the UK, with an anticipated minimum sample response of 10%. The data is analysed and interpreted during the investigation stage, and then compared with the literature to identify the critical success factors for effective ISO 9001 QMS implementation in UK construction projects.

Stage 3) In the validation stage, the identified critical success factors are validated through six semi-structured interviews with project managers from construction companies engaged as contractors within the study domain. Data from the six interviewees is deemed sufficient since it provides the required depth for validation, considering that the collection of the main information about the critical success factors for effective implementation of the ISO 9001 QMS in UK construction projects is achieved through cross-referring the literature and the findings from the quality management questionnaire.

Stage 4) In the final conclusion stage, the research findings and a synthesis of the research objectives are presented, which represent the critical success factors drawn from the literature review in Stage 1 and investigated through the quality management survey in Stage 2, with the findings validated through interviews with project managers in Stage 3 of the research. Therefore, the findings of this research are grounded in the quality management and construction literature, while being established as critical for successful implementation of the ISO 9001 QMS in UK construction projects through a robust process of data collection, analysis and validation. Therefore, the findings emerging from this study will be of interest to quality management practitioners in the field, while offering insight to the contributors of ISO 9001's development on the current perceptions of its implementors in UK construction projects. Recommendations and proposals for future research are also provided based on the findings that emerge.

The structure for this study's progression is depicted in Figure 1.1, showing the activities to be undertaken at each stage of the study in order to achieve the research aim and objectives, and thus answer the research question.

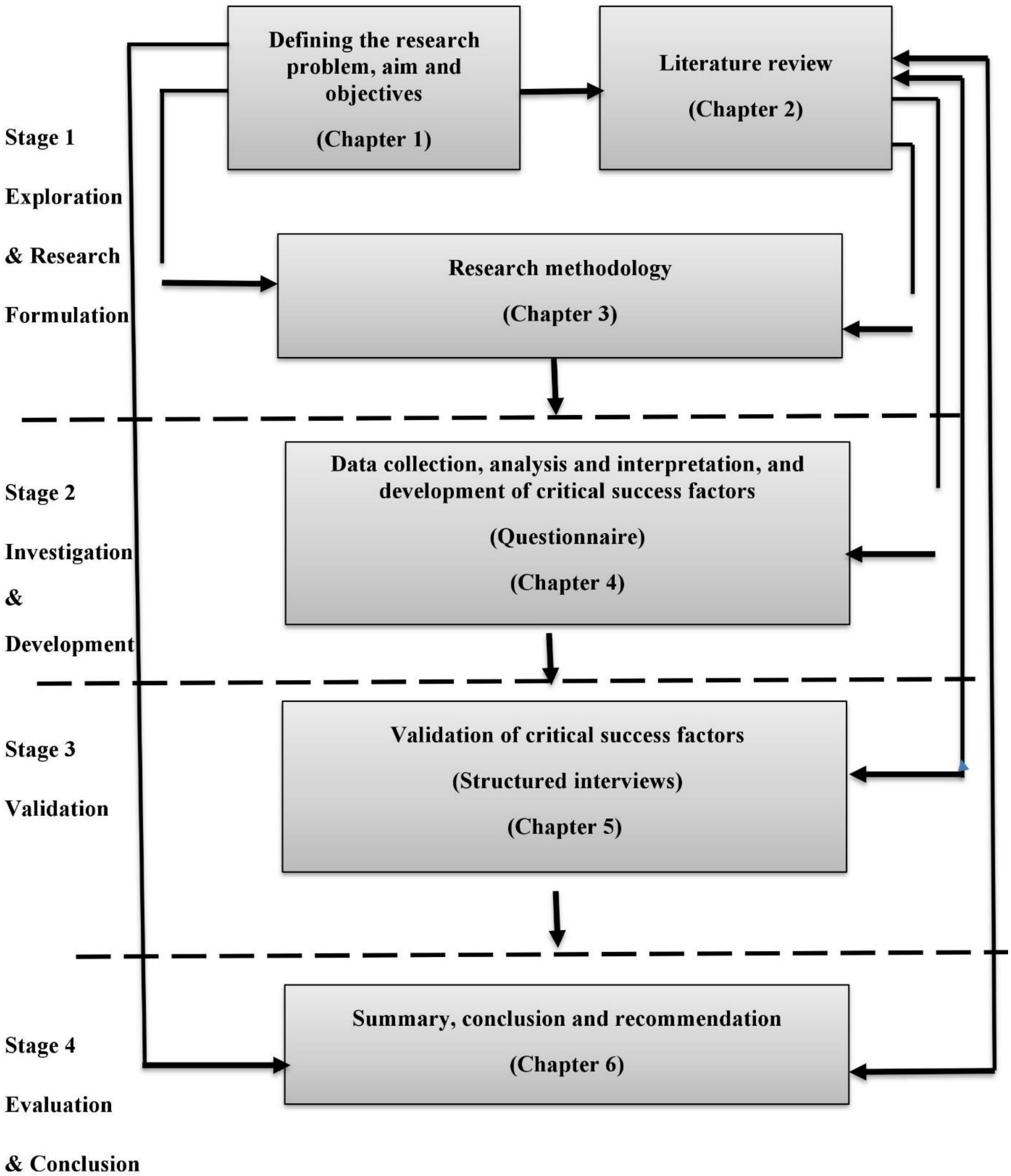

Figure 1.1: Flow diagram of the thesis

1.7 Thesis structure

This thesis contains seven chapters, which are structured as follows:

Chapter 1 presents an introduction to the study, which includes the background of the research in terms of construction projects, quality and quality management. The research problem statement is then stated, which leads to the research question, the research aim and the research objectives. Then, the research scope is presented to define the research, followed by the thesis design and structure.

Chapter 2 investigates the literature to create a foundation for the research in terms of construction projects located within the UK construction industry. The characteristics of construction projects generally, and UK construction projects in particular, are explored regarding the project delivery, the parties involved, the project management and delivery to other sectors of the UK economy. The chapter then concludes by considering the challenges that UK construction projects face in achieving the cost, schedule and quality requirements.

Chapter 3 conducts an in-depth review of the QMS and ISO 9001 literature. The historical background and development of the QMS is given, as well as a discussion on the ISO family of standards, and ISO 9001 in particular, where the development, benefits, and importance of the QMS are considered. Finally, challenges to implementation emerge and provisional critical success factors for the effective implementation of the ISO 9001 QMS in construction projects are drawn from the literature, to enable the development of a methodology and for data collection to take place.

Chapter 4 explores the research methodology in terms of research philosophy, the research approach, the need for either quantitative or qualitative methods (or a combination of the two), an exploration of the available research techniques, consideration of the sampling approach, and the themes of validity and reliability. Through this process, the methodology applied in this study is both established and justified, enabling the data collection instruments to be developed and deployed to gather primary data to fulfil the research aim and objectives.

Chapter 5 presents the primary research findings gathered through a quality management survey conducted with project managers from construction companies engaged as contractors, with the chapter identifying all the provisional relevant factors affecting the implementation of the ISO 9001

QMS in construction projects and discussing the identification of the critical success factors pertinent to UK construction projects on the basis of comparing the main results of the survey with the literature reviewed in Chapter 2 and Chapter 3. The quantitative data collected through the survey is presented in tables and figures to enable to the reader to understand and examine the results, before a series of statistical tests are applied and a list of critical success factors are formulated, pending validation in the final stage of the thesis.

Chapter 6 analyses the critical success factors that emerged from the quality management survey through a validation process involving content analysis of the qualitative data gathered through semi-structured interviews conducted with six project managers, again from construction companies engaged as contractors in the UK. The results from Chapter 5 are examined and are either validated, rejected or extended, leading to a final list of critical success factors for effective implementation of the ISO 9001 QMS in UK construction projects, which achieves the last objective of this research.

Chapter 7 summarises the findings of the research in terms of the achievement of the four established objectives, the findings of the research, a critique of the methodology applied, the limitations, the research novelty, and the recommendations of the study, before concluding by presenting the potential for further research to be conducted in future.

1.8 Conclusion

This chapter introduced the research domain to be explored by this thesis. First, the background of the research was established in terms of construction projects in general, and in the UK in particular, with attention given to the ISO 9001 QMS and the notion of quality. After that, the problem statement was made, which comprises the challenges for construction projects in terms of quality, cost and delays, and the need to address these to enhance client satisfaction, and the perceptions of the industry. Subsequently, the research question was established, as well as the study's aim and objectives necessary to answer the research question. Then, the scope of the research was defined to establish the limits for this research study in terms of the focus of the research (i.e. UK construction projects), the participants (i.e. project managers) and the area of investigation (i.e. critical success factors for the implementation of the ISO 9001 QMS). Next, the research design was presented visually and textually to describe those stages involved in reviewing the literature and then gathering, analysing and validating the data in order to answer the research question and fulfil the aim and objectives of this research. Finally, a description of the thesis structure was presented. The next chapter will review the literature on the UK construction industry and UK construction projects, in order to begin the process of establishing a theoretical foundation for the study.

Chapter 2

UK Construction

2.1 Introduction

This chapter explores the literature to create a foundation for the research in terms of the focus of the study, namely UK construction projects in the UK construction industry. The chapter begins by exploring the characteristics of construction projects through a historical and contemporary lens, as well as the prevailing traits of construction projects as being unique non-repetitive processes. It then moves on to consider the characteristics of the UK construction industry in terms of its performance and contribution to the UK economy, as well as the impacts of political changes such as the UK leaving the European Union, and mega projects like the third runway at Heathrow Airport and the HS2 high-speed rail line. UK construction projects are explored in detail, regarding the challenges involved in their delivery to clients, the myriad of parties involved, how such projects are managed, and the difficulties that arise regarding the industry's ability to deliver its completed projects to other national sectors within the agreed cost, time, and quality parameters. After that, the challenges that construction projects pose in terms of the scope, stakeholder management/expectations and risk management are presented, before the chapter draws to a close with a conclusion.

2.2 Characteristics of construction projects

The history of construction extends back thousands of years, from the first shelters constructed with mud and stone primarily for residential purposes, to the mud bricks and timber construction utilised during early Greek settlements, and then moving on to more complex construction processes and materials developed during the Roman, Middle Ages and Industrial Revolution periods (Rumane, 2018). The invention of the crane to manoeuvre large weights such as stone during the construction process has been attributed to the Ancient Greeks, where evidence suggests such lifting machines were used to construct the early Greek architecture from the sixth century BC onwards (Pierattini, 2018). The construction project can be described as a non-permanent activity established to produce a final outcome, having a unique and temporary aim that is achieved through gradual progress, and needing to source different parts such as software, hardware or other components, while a client is required, and stakeholders are always included (Schwalbe, 2015). According to Whelton (2004), the project definition phase identifies the needs and values of the project's stakeholders and aims to develop a satisfactory design solution. The purpose of the project is developed through the stakeholders' needs and values. The notion of project management suggests engaging with knowledge, methods, practice, skills, and tools in order to fulfil the project's needs. Not only must project managers strive to achieve the respective goals of cost, scope, quality and time, but they also need to ensure progress, which means responding to the client's expectations and needs (Schwalbe, 2015). Management projects can be defined as harnessing knowledge, techniques or tools that assist the organisation in achieving superior results while meeting the project's requirements (Farzaneh and Shamizanjani, 2014).

According to Martin and Tate (2002), project management is vital to ensure that deadlines are met with lower costs while efficiently and effectively meeting the required objectives, with each project featuring individuals who are directly involved. Organisations' use of project management has steadily increased over recent decades, and despite some evidence that projects are becoming more successful, Allen et al. (2014) cautioned that a substantial number of projects still do not meet the stated goals or expectations. In terms of measuring construction project success, Davis (2016) developed a method to conceptualise, diagnose and comprehend the dimensions through inductive thematic analysis, where she identified three dimensions of project success that are directly associated with the perceptions of success: (i) benefits for the stakeholders, (ii) addressing specific client concerns, and (iii) cost, quality and time.

Construction projects, however, are characterised by their unique non-repetitive nature, in contrast to the manufacturing sector where processes can be implemented, refined and duplicated (Rumane, 2018). There are limited means through which to reduce this variation that prevails in the construction sector in order to enhance performance (Latham, 1994). Furthermore, construction projects are complex undertakings in terms of the stakeholders involved, which include the client's team, comprising of a project manager and consultants; the design team, including architects, consultants and engineers; and the contractor in terms of the organisation selected by the client to carry out the works (Rumane, 2018).

Simona et al. (2011) indicated that project management is an art that requires skill, precision and tact in order to manage people, as well as being a science that demands deep awareness of a range of mechanisms and instruments for the management of relatively immediate measures with a fixed budget that ultimately should fulfil or surpass the client's requirements and expectations. This entails balancing the competing stakeholders' demands in terms of the cost, quality, scope, and time with the recognised expectations and necessities (Dumitrascu and Nedelcu, 2012). All projects feature characteristics in terms of the design of proposals that are then transformed into new tasks and outcomes. The ever-present threats and uncertainty reveal that those measures required for the effective implementation of projects cannot be planned with complete certainty in the case of projects that are highly complex, while the notion of their successful conclusion can be questioned (Project Management Institute, 2008). A range of expertise, methods, principles, rules and tools are employed for planning, which are required to commence and successfully complete a project (Aized, 2012). Furthermore, the nature of project management comprises of a system that is grounded in capital, people and time. Every stage of the project's progression contains a range of processes that have to be concluded prior to the project transitioning to the subsequent phase, where process control groups need to be employed in order to describe these procedures within the respective project phase and ensure success in terms of the implementation. Depending on each project's classification, different combinations of processes should be utilised for successful completion. This measure considers the accessibility of resources, the application area, the duration, the experience of the industry and institution, the maturity, the risk, the scope and the size. Contained within each project development phase are many processes that need to be completed prior to the project being able to transition to the subsequent phase by ensuring successful implementation (Dumitrascu and Nedelcu, 2012). A summary of the process groups potentially conducted at any project stage is provided in Figure 2.1 (Angelo State University, 2012).

Quality management is vital facet of project management, whereby for the project's performance to see continued growth and improvement, quality must be managed effectively in terms of not only the cost and time, but also the quality requirements and specifications (Dumitrascu and Nedelcu, 2012). In the context of the project process groups presented in Figure 2.1, the initiating process group defines the new project, or an existing project's new phase, through securing the permission necessary to commence the project or phase; in the planning process group, the processes are established regarding the project's scope and the objectives, with the quality management plan developed; the executing process group defines those processes necessary to complete the work and meet the project's requirements, while quality is managed; the monitoring and controlling process group conducts processes to monitor, review, and regulate the project's performance and progress, while identifying any requirements for change and monitoring for quality; and finally, the closing process group performs the processes necessary to complete the project and ensure that the client is satisfied with the quality outcomes of the project (Project Management Institute, 2017).

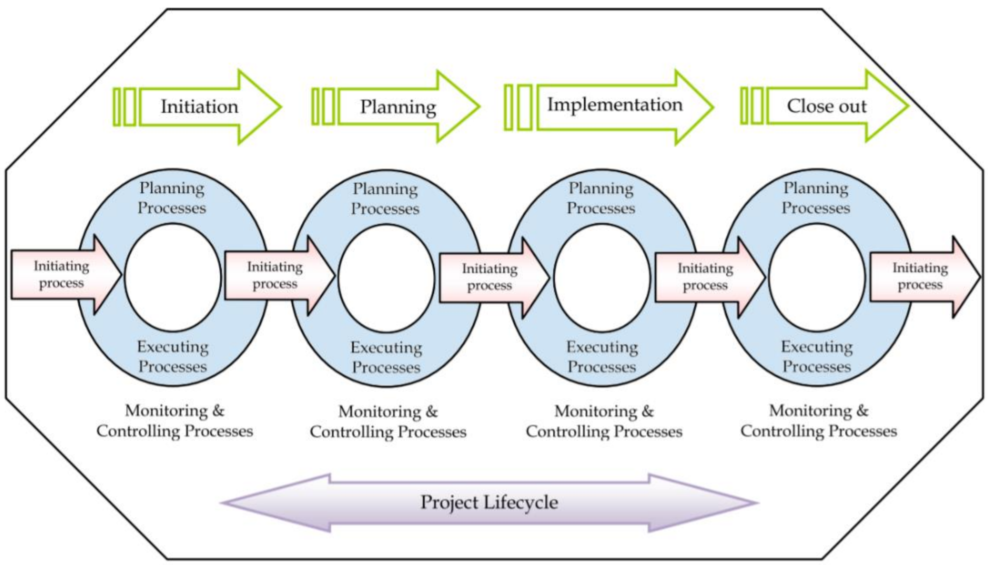

Figure 2.1: Project process groups (Angelo State University, 2012)

2.3 UK construction industry

The UK construction industry is an important sector for the national economy, providing 2.37 million jobs in 2019, representing 6.7% of all employment in the country (Rhodes, 2019). The sector is particularly noted for its high proportion of self-employed workers, owing to their contracts to engage on specific projects (Rhodes, 2019). In 2018, new orders in the sector comprised £61.7 billion, a 13% decrease on 2017 (see Figure 2.2), which can be partly attributed to the awarding of high-value HS2 contracts in 2017, to develop a high-speed rail network connecting the major cities of the UK. Negative output can also be noticed following the recession in 1990–1991, and the global financial crisis in 2008. The number of construction businesses active in the construction industry rose to its highest level of 325,736 in 2018, with the East, South-East and London regions providing 41% of the employment in the sector (Office for National Statistics, 2019). In comparison with European nations, Figure 2.3 presents the output and activity of building and civil engineering projects based on the monthly output in December 2019 (Eurostat, 2020), and thus unaffected by the impact of COVID-19 on the industry in early 2020. The base year is 2015, and it can be seen that while the UK output is strong, there is particularly vibrant output in the central European countries of Hungary and Austria, as well as in the Netherlands and Croatia, representing the caution of clients committing to new UK projects during the uncertainty of the country leaving the European Union (i.e. Brexit). On this theme, Partington (2019) reported that construction work on large infrastructure projects in the UK had experienced its largest decline since the 2008 recession, reportedly due to the negative impact of Brexit on political decision-making, and particularly on megaprojects such as the third runaway at Heathrow airport and HS2.

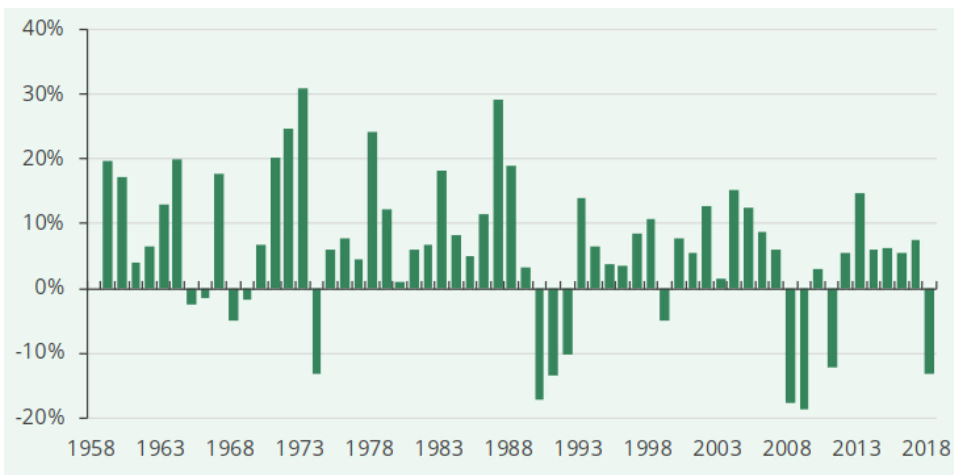

Figure 2.2: New orders to the UK construction sector from 1958 to 2018 (Rhodes, 2019)

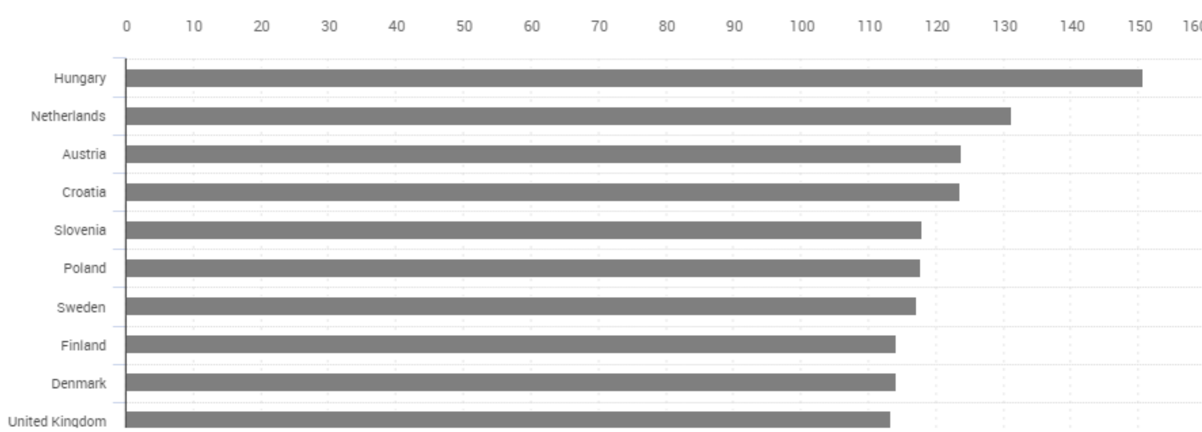

Figure 2.3: European production in construction: December 2020 (Eurostat, 2020)

The UK construction industry involves a broad range of organisations and actors comprising of contractors and sub-contractors, engineering consultants, architects, quantity surveyors and suppliers engaged in projects such as building, engineering, off-shore work and industrial plants (Rostami et al., 2015). Sub-contracting is widespread in modern construction projects due to the high complexity of contemporary buildings (Milner, 2019). In 2017, new construction orders were dominated by housing (35%), commercial (25%) and infrastructure projects (19%) (Rhodes, 2019). The UK government has placed continued focus on the construction industry, which is exemplified by Sir Michael Latham's 1994 report titled *Constructing the Team*, which looked for solutions to the industry's poor performance during the late 1980s and early 1990s, where 500,000 jobs and 35,000 small businesses were lost due to the impact of the 1990–1991 recession (Adamson and Pollington, 2006). More recently, the UK government has developed a clear vision for the development of the construction industry, in its 2013 strategic paper titled *Construction 2025*. Ambitious efficiency targets were set for a 33% reduction in the cost of the construction, as well as the costs over the lifetime of the built outcome, and a 50% reduction in delivery time for new and refurbished projects. Targets were also set for a 50% reduction in the trade gap between imports and exports of construction materials and products, and a 50% reduction in greenhouse gas emissions (HM Government, 2013). Adrian Malleson, head of research, analysis and forecasting at the National Building Specification, asserted that such productivity savings would need to be driven by innovation, such as how in recent years data has been collected, aggregated and recycled to achieve new outcomes, and enhance existing performance (Malleson, 2014).

2.4 UK construction projects

With the global environment becoming increasingly competitive, and particularly in the UK, construction projects encounter a range of complex issues due to the challenges of a host of different activities, sequences and potential approaches to a construction project, each of which involves its own specific risks (Ellingham and Fawcett, 2007; Ning et al., 2011); for example, the complex and contractually varied relationships of those who are involved, the large volume of materials and tools necessary to manoeuvre and install materials, and the fact that most of the items required for use on construction projects are manufactured elsewhere, leading to significant risk in terms of the time and cost domains (Rumane, 2018). As a result, the effective management of knowledge and skills is vital (Hameed and Abbott, 2017), with the project team being responsible for ensuring that all employees are equipped with the necessary competency to create value through their empowerment and engagement (Willar et al., 2015). Singh et al. (2018) postulated that the failure of some UK projects is due to issues such as poor engagement between the stakeholders of the project, as well as absent or weak practices of project management, whereby the poor management of stakeholders during construction projects can lead to undesirable consequences that include the overrun of costs, considerable delays, and in the worse-case scenario, the premature conclusion of the project. Moreover, threats arise due to insufficient loyalty from project management staff, as well as the challenging environment (Hadavi and Krizek, 1994). Significant focus has been placed on client relationships and satisfaction due to the considerable competition in the construction sector (Kumar and Balakrishnan, 2011; Fonseca and Domingues, 2017a), despite such relationships tending to only exist for the lifecycle of the project (Arditi and Gunaydin, 1998). Therefore, it is essential for stakeholders to be managed effectively by organisations in order for the project goals to be realised. A study conducted by Rostami et al. (2015) to investigate the challenges and competition that small and medium-sized construction companies encounter and the risk management measures implemented by 153 UK companies, concluded that the main challenges to be overcome were scaling the risk management processes, limited awareness of which techniques and tools to employ to support risk management processes within the organisation, conducting risk management in a cost efficient manner, and poor culture of practice. The authors concluded that a risk management framework was required to achieve a balance between the resources, requirements and preferences in small and medium-sized construction companies (Rostami et al., 2015). In terms of the available standards, none of these clarify the central principle of the application of resource management to the scenarios that small and medium-sized construction companies tend to encounter. This issue is compounded by limited management know-how and skills regarding the utilisation of resource management instruments or approaches to allow the identification and analysis of the company's risks, while analysing the construction processes statistically is challenging because they are non-repetitive (Haupt and Whiteman, 2004). In another study conducted by Hameed and Abbott (2017) on the UK construction sector, it was found that a range of components can profoundly influence the project's success and collaboration between stakeholders, the most important of which is that the clients consider increased commitment and trust to represent vital factors for the successful outcome of projects and alliances amongst stakeholders. Their study underscored the importance of clients and stakeholders acquiring an enhanced understanding of these essential factors for success, while the restriction of knowledge-sharing represents a significant obstacle to a successful project outcome since it results in reduced levels of trust amongst the stakeholders. Fonseca and Domingues (2017a) reported the need for personnel to be competent, deliver value and to have a positive perception of their role's importance by ensuring the staff have the required level of education (White and Marasini, 2014). Moreover, if the client, stakeholders and project team lack an effective communication strategy, the project is likely to underperform or potentially fail.

Despite project managers' attempts to enhance the potential for project success through quality management, which enables an organisation to demonstrate its capability and provide the client with the confidence that their needs and expectations will be met (Hoyle, 2018), there are many challenges that range from organisational-based issues such as the absence of support for implementation, to poor motivation from construction personnel to accept QMSs (Rumane, 2018), as well as insufficient awareness of ISO 9001's requirements for quality systems (Harrington et al., 2012), and the limited funding available for management programmes due to competition and lean profit margins (Boiral, 2003). In terms of motivation, Sickinger-Nagorni and Schwanke (2016) underscored the need for personnel to experience empowerment, satisfaction, to feel involved in their role and to have commitment to the organisation. Another study by Marasini and Quinnell (2010) investigated the status of quality management in large UK-based ISO 9001-certified construction companies though a survey that analysed the perceptions of 35 site managers working on a total of 11 different projects in the South-East, South-West and Midlands regions, ranging from schools, hospitals and hotels, to infrastructure projects and business parks. The study's findings suggested that while the site managers had familiarity with the techniques employed to assure quality in their projects, they had received limited training in such techniques, relying heavily on their particular experience and demonstrating a lack of consistency in terms of communication and methods. Moreover, the site managers expressed a wish to increase their awareness of QMSs, the procedures, and their relevance to ensuring that projects are delivered with the required degree of quality, although Landin (2000) underscored the challenges of determining quality standards. Al-Najjar and Jawad (2011) found poor experience in the conducting of internal audits due to limited understanding of the QMS.

The notion of quality management involves ensuring well-planned and organised efforts are undertaken to allow the achievement of an acceptable degree of quality; however, sudden changes in the market pose a threat by refocusing the project management from attaining the long-term objectives to urgently implementing corrective action (Harrington et al., 2012). From a construction company's perspective, the management of quality in construction projects implies construction works being maintained at the stipulated standard of quality in order to achieve client satisfaction, which represents the ultimate desired outcome of ISO 9001 (Hoyle, 2018), while continuous improvement involves the project management continually working to improve through assessing their performance and implementing measures for improvement (Willar et al., 2015; Anttila and Jussila, 2017). Quality management is an essential requirement for construction companies' survival in the currently highly competitive and challenging construction market, where quality management is responsible for creating an environment whereby the associated procedures, techniques and tools can be effectively deployed, resulting in successful outcomes. Therefore, rather than being an isolated activity for a construction company, the quality management role is interlaced with all the project's managerial and operational processes, which should be structured to effectively and efficiently achieve the particular objectives (Sickinger-Nagorni and Schwanke, 2016). Nevertheless, with the contractor typically selected based on price (Harrington et al., 2012), and the client placing less importance on the experience, current workload, and reputation for quality (Thomas et al., 2002), additional threats present in terms of the resources available to implement quality management.

2.4.1 Project delivery

Hoyle (2018) discussed the need to monitor external provider's performance to ensure that the procurement process's output meets the requirements of the organisation, where he highlighted that late delivery will have implications for all subsequent processes. Rumane (2018) considered the range of delivery systems that can be applied to ensure project completion in a manner that meets the client's needs and expectations, as presented in Table 2.1 below.

Table 2.1: Project delivery systems (Rumane, 2018)

Category	Classification	Subclassification
Traditional system (separated and cooperative)	Design–bid–build	Design–bid–build
	Variant of traditional system	Sequential method
		Accelerated method
Integrated system	Design–build	Design–build
	Design–build	Joint venture (architect and contractor)
	Variant of design–build system	Package deal
	Variant of design–build system	Turnkey method (engineering, procurement, construction)
	Variant of design–build system (turnkey)	Build–operate–transfer (BOT)
		Build–own–operate–transfer (BOOT)
		Build–transfer–operate
		Design–build–operate–maintain
	Variant of design–build system (funding option)	Lease–develop–operate
		Wraparound (public–private partnership)
	Variant of design–build system	Build–own–operate (BOT)
		Buy–build–operate
Management-oriented system	Management contracting	Project manager (program management)
	Construction management	Agency construction manager
		Construction manager-at-risk
Integrated project delivery system	Integrated form of contract	

These delivery systems include (i) the Design–Bid–Build contract, whereby the client engages with design professionals to prepare the design and contract documentation, which contractors then utilise to make competitive bids; (ii) the Design–Build contract, through which the client engages with a single company to design and build the project; (iii) the Build–Own–Operate–Transfer contract, which is typically employed by governments for the development of public infrastructure, whereby the private sector finances, designs, operates and manages the facility for a fixed period of time, before transferring ownership to the government; (iv) the Turnkey contract, where the client engages with a single organisation to design, procure, build and commission the project; the Project Manager contract, whereby the client engages with a project manager to deal with the planning, monitoring and management of the project; (v) the Construction Management contract, through which the client contracts a firm for project coordination and to offer the service of construction management; and (vi) Integrated Project Delivery, where the client, contractor and designer collaborate and collectively assume responsibility for the risks and liability of the project's delivery (Rumane, 2018).

Picken and Liyanage (2017) conducted a questionnaire survey to explore the views of members of the CIOB in terms of the key leadership qualities that result in the successful delivery of complex UK-based construction projects. From the 186 responses, they found that the qualities of effective decision-making (e.g. resolving issues in a timely manner), monitoring and controlling (e.g. recognition that complex projects cannot be micro-managed), planning (e.g. the ability to separate a task into more manageable pieces) and teamwork (e.g. the selection of team members who are qualified and experienced) were the key leadership attributes associated with successful project delivery.

In terms of the delivery phases, Mehta et al. (2018) described five phases: predesign, where the client and his or her team develop the details of the project; the design phase, after the selection of the architect; the preconstruction phase, where the bidding documents are prepared; the construction phase, where construction project is commenced; and postconstruction, where the completion status is assessed. From a UK perspective, Sinclair (2019) presented the Royal Institute for Architects' Plan of Work 2020 (see Figure 2.4), which features eight stages that range from the strategic definition to ensure that the project outcome has the greatest potential to fulfil the client's requirements (Stage 0), to the technical design being established at Stage 4, the manufacturing and construction processes being undertaken in Stage 5, and finally the client being in receipt of the completed project at Stage 7. This updated plan of work reflects the increasingly complex nature of the project team, since interaction between the design and construction teams now has to cater for certain aspects of the project being undertaken by specialist sub-contractors, as well as the use of contemporary construction approaches (RIBA, 2020).

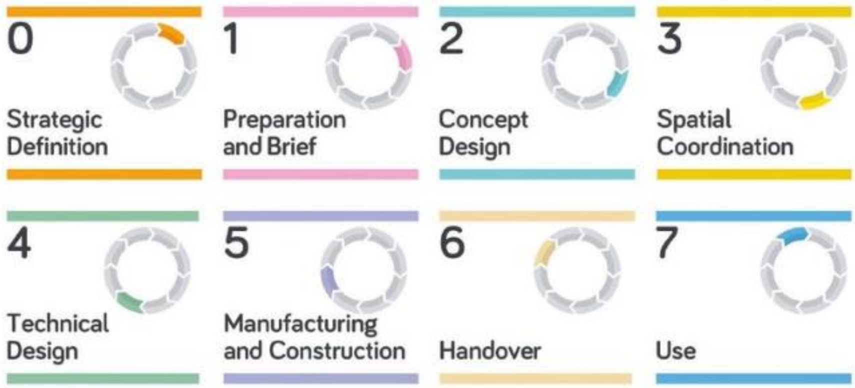

Figure 2.4: RIBA Plan of Work 2020 (Sinclair, 2019)

In their study exploring the challenges of UK construction projects in terms of the practices for regulating the project cost and time control, Olawale and Sun (2014) conducted a questionnaire survey of the top 250 companies (as measured by turnover, number of professional staff employed and fee earnings), followed by interviews with 15 practitioners (the majority directors and senior managers, with considerable experience in the project management of building construction). Following analysis of the qualitative and quantitative data, the study found having independent personnel available at the next tier of management to assess reports to be of critical significance, while (i) forecasting the cost and completion time, (ii) ensuring the inclination to release information promptly to aid analysis, (iii) engaging in the comparison of cost-versus-value analysis, and (iv) ensuring the integration of cost and time during analysis were found to be important in terms of dealing with issues relating to project control. Therefore, the researchers recommended 65 best practice items for improvement of the planning, monitoring, reporting and analysis of project control tasks (Olawale and Sun, 2014).

Gledson and Greenwood (2017) reported that through examining standard key performance indicator (KPI) data, over half of all construction projects in the UK did not meet their planned schedules in terms of time. Therefore, and as mentioned above in section 2.3, in its *Construction 2025* strategy report the UK government has set efficiency targets that include a 50% reduction in delivery time for construction projects. In their study exploring how, why and the speed at which new approaches and technology disperse, Gledson and Greenwood (2017) conducted a survey with

97 construction planners and found that in terms of 4-dimensional (4D) building information modelling (BIM) (see section 3.3.1.4), there was a delay between becoming aware of the innovation, and implementing it for the first time, thus exemplifying the challenges of introducing more efficient technologies in the construction industry. Moreover, Gledson et al. (2018) reported that many of the delays and poor performance associated with the construction industry originate from the poor time performance of the phases, tasks, and work packages in construction projects. The authors conducted quantitative analysis on secondary data taken from a total of 720 construction tasks that had been competed in order to analyse the time performance. Their data came from three competed and one partially completed project undertaken by three leading UK construction organisations, where they found that regarding the efficiency of the planning and delivery, only 38% of activities in the project commenced and concluded on time. Gledson et al. (2018) thus encouraged further research to investigate the time successes of projects that applied traditional approaches to construction planning, versus projects that applied innovative approaches such as 4D BIM.

The delivery of large projects on time is thus problematic, with close to 60% of construction industry projects delivered later than agreed over a twelve month window in the 2014–2015 period, where the contributing issues included the movement of talent into other sectors after the financial crisis of 2008, the limited development of innovative technologies, and design delays due to the complexity of the project (Schouten and Wilson, 2015). In terms of the HS2 high-speed railway line, the project is reported to be running over budget, which has increased from £22 billion to £56 billion at 2015 prices, while completion of the first phase that will connect London to Birmingham had a five-year delay to the delivery timetable as of 2019 (Topham, 2019). Therefore, it was reported to the Department of Transport in March 2019 that the project could not be delivered to the agreed schedule and cost (Price, 2020). Issues have included the inability of some contractors to produce designs at a reasonable cost, while one of the main contractors (Carillion) collapsed in 2018, further complicating the project (Topham, 2019).

Negative impacts on the cost and schedule can thus develop during the planning phase due to the lack of innovative approaches, poor determination and integration of cost–time analysis, and delays due to the design of complex projects. During the implementation phase, challenges such as timely information release, lack of talent, and the contractor falling into receivership all present challenges to the delivery of the different phases of the project on time and budget.

2.4.2 Parties

The management of the stakeholders of the project includes those processes necessary to identify the groups, organisations or people that either impact or could be impacted by the project in order to understand their expectations and to develop strategies to manage these parties effectively in terms of the decisions and implementation of the project's activities (Project Management Institute, 2017). Construction projects involve many parties, that range from the core client, the design team, the financiers and the project management team, to the broader stakeholders such as the local communities, special interest groups, local and national authorities, professional organisations, and environmental organisations (see Figure 2.5), with the client positioned centrally amongst these (Ryd, 2014), and the client and main contractor typically agreed as being of great important (Bal et al., 2013).

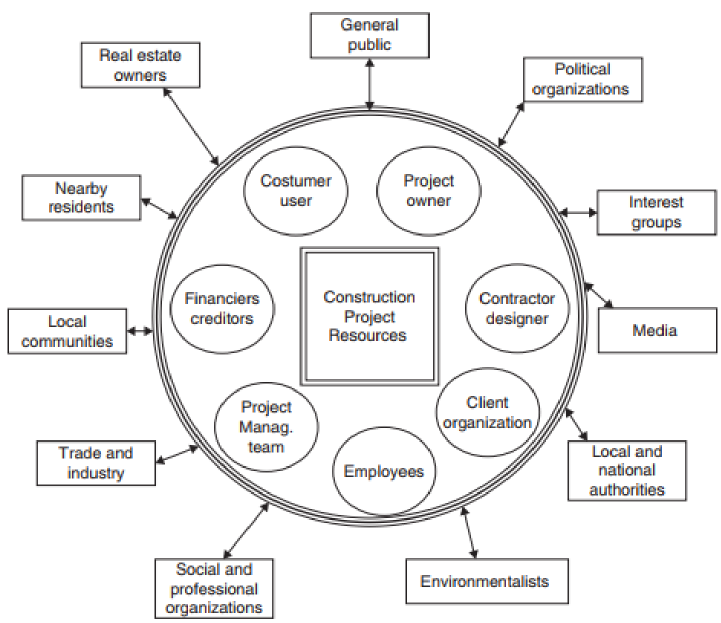

Figure 2.5: Construction project stakeholders (Moura and Cardoso Teixeira, 2010)

Newcomb (2003) argued that owing to the complexity of the investment and interest in modern construction projects, the notion of the client, which was central throughout the twentieth century, has been superseded by the stakeholders of the project, while highlighting the importance of project stakeholders conducting analysis to determine the interests, power and predictability of the main project stakeholders. Cheng (2008) conducted research into the impact of strategic decisions on the satisfaction of UK construction clients, where through the quantitative data collected from 72 private- and public-sector clients he found that service delivery and communication with the client were key factors to ensuring client satisfaction. In their qualitative study to explore how trust can be established in the project–stakeholder relations, Karlsen et al. (2008) used Oslo's New Opera House as a large case study and conducted 11 in-depth interviews that focused on the project management team, finding that the construction of trust is established on a foundation of strong communication, predictable behaviour, commitment, sincerity, competency, integrity, the achievement of milestones in the project, and setting mutually agreed targets. Then, in their study exploring expertise in the decision-making processes of large UK infrastructure projects, Dudley and Banister (2018) considered trunk roads and HS2, where they found that in highly complex transportation projects, the significance of expert opinions erodes over time, and thus there needs to be a shift away from the expectation that experts can provide conclusive evidence for the justification of a particular decision, and that ultimately there is a political dimension to such decision-making.

Conflict among stakeholders can lead to significant challenges for construction project managers, imposing negative impacts on the delivery of the project through escalating costs and considerable delays (Hansen-Addy, 2013). However, Moura and Cardoso Teixeira (2010) underscored that conflict in construction projects may not necessarily lead to negative outcomes, as although 'dysfunctional conflict' will impede progress, 'functional conflict' results in improved processes of production, and thus better outcomes. The origins of conflict between the client and contractor in construction projects could be due to unsatisfactory levels of quality or higher-than-agreed costs, and can be considered in terms of cognitive conflicts, due to differing interpretations of data; conflicts of interest, involving the sharing of benefits or increased costs; normative conflicts, in terms of the expected behaviours, norms and values; and relationship conflicts, arising from clashes of behaviour or personality (Moura and Cardoso Teixeira, 2010). Hansen-Addy (2013) conducted research to identify the primary causes of conflict in UK construction projects and analyse the approaches to conflict resolution. In his study, 36 questionnaire surveys were completed by clients, contractors, consultants, local planning authorities, and project managers in the UK construction industry to collect qualitative and quantitative data, where he found that disputes with the contractor were inevitable due to their pivotal role in project delivery; that conflicts over priorities, schedules and technical issues were commonplace; and that over the project's lifecycle, conflict levels peaked during the main project implementation phase. In terms of solutions, soft conflict resolution was more popular than resorting to arbitration and litigation, since this avoids litigation costs, delays, and the impact on stakeholder relationships when such measures are taken, with negotiation and compromise emerging from the research as the preferred approaches to resolve conflict (Hansen-Addy, 2013).

In his investigation of the UK construction industry and the origins of disputes in terms of sub-contracts, Milner (2019) conducted four practice-based inquiries and sixteen semi-structured interviews with sub-contractor and main contractor organisations either known to have been involved in such disputes, or members of professional bodies such as the Confederation of Construction Specialists (CCS) and the CIOB. The study found that no specific measures could be implemented to avoid disputes in the sub-contractual relationship, nor could any single root cause for disputes be identified, although the main disputes originated from the sub-contract agreement, procedures and risk, and the behaviours of the people involved. While the specific origin(s) of a dispute could be identified in individual construction projects, even that task was challenging due to the complexity of such projects and the contractual arrangements involved. At the micro-level, disputes were found to negatively impact on profitability and productivity, be time-intensive to resolve, and have the potential to permanently damage business relationships (Milner, 2019). Gerrard (2018) reported that the most common reasons for disputes in UK construction projects are where the contract has not been administered correctly, followed by the parties' failure to comprehend their contractual obligations, and then by parties not serving sufficient notice, as specified in the contract. Nevertheless, in terms of the actual value of construction disputes in the UK, this fell by 47% in 2018, with the 'willingness to compromise' having the greatest impact on dispute avoidance, whereby the majority of disputes are resolved once the issue becomes clear, with negotiation remaining the preferred conflict-resolution mechanism (O'Connor, 2019).

2.4.3 Project management

The project manager performs a vital leadership role in the project team to realise the project's objectives, with the role prominent throughout the project, and project managers frequently being involved from the project's initiation to its conclusion (Project Management Institute, 2017). Moreover, they have the potential to ensure real benefits for the project through their thorough understanding of the need for and perspectives of a consultancy team, providing high-calibre management skills and adding value at each stage of the process (Nelson, 2006). The project manager thus has responsibility for the management of the project on a day-to-day basis, and needs to be proficient in the management of six key facets of the project: finance, quality, resources, risk, scope and time (Naoum et al., 2018). Rolfe and Chilsehe (2006) discussed the emergence of the project manager at the head of the design team, and in their study that surveyed 29 architects, engineering practices, project managers, quantity surveyors, and main contractors from the construction industry in the UK, they explored the most suited profession to fulfil the role of the project manager on contemporary projects. They found while each of the professions was equipped to fulfil the role, those from a quantity surveying background were deemed to be the optimum due to their strengths in time management, although they underscored that the project manager performs a holistic role that requires many of the skills found within the design team. The Construction Industry Council (2001) recognised four tiers of project management that are typically associated with the project manager, who has main input at each tier: (i) Project Management, responsible for the overall management of the project; (ii) Design Manager, with management responsibilities for the design process; (iii) Construction Manager, with management responsibilities for the construction process; and (iv) Trade Contract Manager, responsible for the management of the specialist sub-contractors. Figure 2.6 presents the competence and awareness requirements for the skills required at each tier of management in terms of the strategic, project control, technical, commercial, and organisation and people domains, where it can be seen that while awareness may be gained, competency in all the skills would be unfeasible to the broad scope.

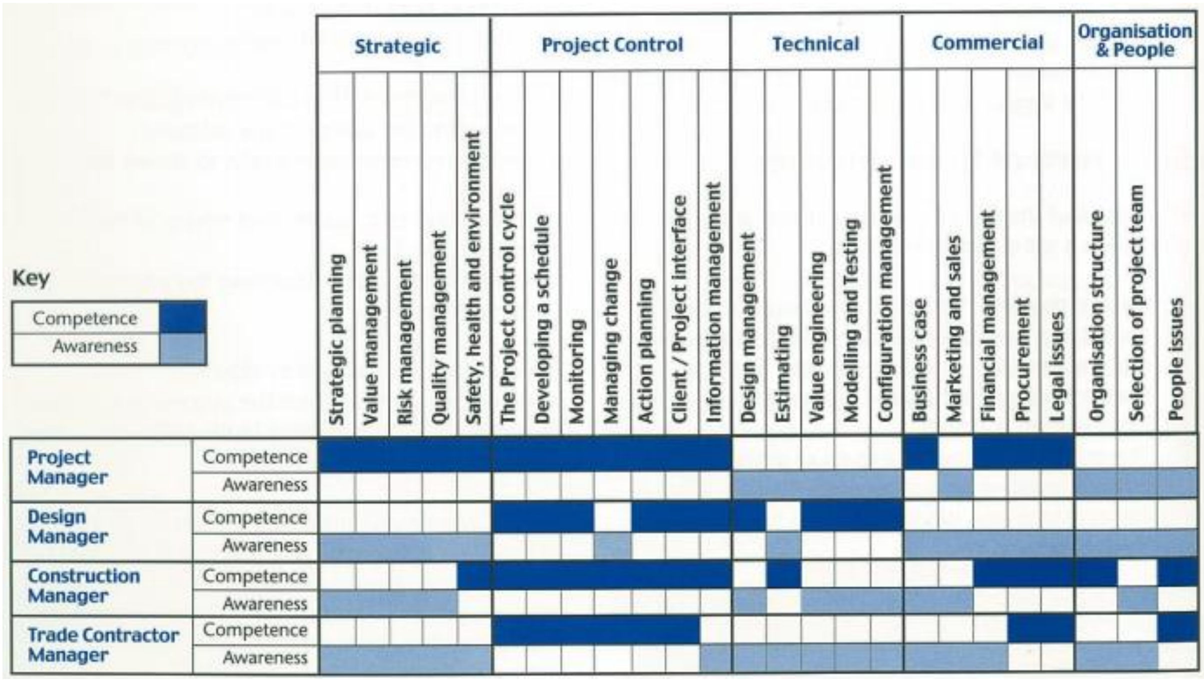

Figure 2.6: Skills' requirement for the range of project management roles (Construction Industry Council, 2001)

Picken and Liyanage (2017) explored the key attributes of leadership that result in successful project delivery on complex UK construction projects through 186 questionnaire survey responses completed by members of the CIOB, where they identified the attributes of teamwork and controlling, monitoring, and planning to be vital for projects in general, and for addressing the decisions associated with issues that arise. Naoum et al. (2018) conducted a quantitative questionnaire survey of 44 UK construction project managers who primarily worked from small and medium-sized companies where the average contract value over the previous five years had ranged from £1 million to £30 million in value. They sought to determine the relationships existing between stressors, stress, behaviours to manage stress and the performance of construction projects managers, where they found that burnout had the greatest negative impact on interpersonal performance, while physiological stress reduced the task performance, thus highlighting the challenging environment that construction project managers enter, and the need for consideration of how future professionals make the transition from academia to practice. In their study to determine the impact of the project manager on project success, Ali and Chileshe (2009) conducted a questionnaire survey with 29 respondents from UK construction companies selected from the

FAME (Financial Analysis Made Easy) database, where they found a strong correlation between the project manager's effectiveness and the likelihood of a successful project outcome, and with authority, knowledge and experience associated with quality, the authors asserted that these characteristics should be taken into account during the project manager's selection process in order to increase the likelihood of high-quality project outcomes.

In terms of the management of quality in a project, a team approach is vital to enhance the quality of the work in all functional areas, and thus collaboration within the project team is essential (Rumane, 2018). However, the top five key skills required by a project manager differ considerably depending on the type of project (e.g. the size or degree of risk involved), with Krahn and Hartment (2006) reporting on the need to ensure that the project manager has the skills and competencies necessary for the specific characteristics of the project being undertaken, following their Delphi study of 60 project management specialists in Canada that included focus groups and a survey. In their paper on achieving quality improvement in a UK medical context, Jones at al. (2019) encouraged developing good project management skills, being enthusiastic and persevering, being willing to explain the project to others and seeking collaborative support as being key skills within the project team in order to improve quality.

Work to improve quality in the construction industry remains, however, as highlighted by the recent Building in Quality (RIBA, 2018) report commissioned jointly by the Royal Institute of British Architects (RIBA), the Chartered Institute of Building (CIOB) and the Royal Institute of Charted Surveyors (RICS), which highlighted amongst other issues, the fragmented procurement process and complex contractual arrangements, leading to governance issues in reaching the target for quality throughout the project, as well as clients often losing sight of the quality objectives in order to reach the cost and time targets, meaning that the professionals on the project team may not have clarity regarding the actual quality objectives of the project.

2.4.4 Project delivery to other sectors

Regarding project delivery to different sectors, the UK housing sector has experienced issues in terms of delays that reduce the project performance and erode client satisfaction, with McCord et al. (2015) investigating delays within the construction of private housing in Northern Ireland. The researchers developed a table of 75 attributes of construction delays and conducted a quantitative questionnaire survey utilising Likert scales to gather the responses of 49 respondents who had over 10 years of experience and were members of a relevant housing construction or professional body. The findings highlighted weaknesses in site management, poor communication strategies and a paucity of coordination between the construction projects' key stakeholders as the main contributors to the delays, which they believed can be generalised to the broader UK construction industry due to its relative underachievement in terms of value chain integration and profitability when compared to other national sectors (McCord et al., 2015). Moreover, the UK Government's All Party Parliamentary Group (APPG) for Excellence in the Built Environment's 2016 *More Homes, Fewer Complaints* report showed a drop in the satisfaction of new home owners from 90% in 2014 to 86% in 2015, implying 15,500 unsatisfied new home buyers (RIBA, 2018). The HomeOwner's Alliance asserted that a decline in the popularity of new homes may be due to perceptions of poor-quality construction, as cited by 38% of the respondents (APPG, 2016).

The case of the HS2 high-speed train line is an example of a mega infrastructure project, where failures to determine the risk and complexity of the programme have led to significant cost increases (58% above budget) and delays (currently 7 years behind deadline) (Reina, 2020), although a National Audit Office (2013) report cites the prevalence of optimism bias that persists in public-sector projects, eroding perceptions of good value for money as the benefits tend to be over-estimated, while the costs are typically under-estimated. An extreme case of project failure involves the public-sector Grenfell Tower refurbishment in West London, where in 2017 a total of 72 residents tragically lost their lives due to the use of a flammable external cladding material that exacerbated the vertical spread of fire through the building, where the person responsible for the day-to-day management of the project had not completed his professional qualifications and the architect had neither worked on high-rise projects nor had experience of working with the composite material used in the cladding (Booth, 2020), The wider effects of the cladding failure have been experience by close to 500,000 UK residents who now live in apartments deemed unsafe due to the risk posed by the flammable cladding that envelopes their homes, representing one of the most significant UK building crises in terms of safety in recent history (Association of Residential Management Agents, 2020). The ramifications are huge, with 272 private sector buildings, 160 social sector buildings and 9 private buildings deemed unlikely to meet building regulations' guidance on fire safety (Statista, 2020), with the cost of replacing the unsafe cladding in London alone estimated to be £4 billion (BBC News, 2020). Then, in Scotland, a report was published in 2017 highlighting defects that resulted in the closure of 17 Edinburgh schools built and maintained by the Edinburgh Schools Partnership private consortium, due to the collapse of a wall at one (Ing, 2018), leading the CIOB, alongside other industry bodies, to discuss this issue in terms of quality, leading to a 2018 initiative in association with the RICS and RIBA titled *Build in Quality*, and the CIOB's *Code of Quality Management* (CIOB, n.d.). This Code (CIOB, 2019) cites the Chartered Quality Institute's notion of quality requiring robust governance of the organisational aims, strong assurance systems to keep things on track, and a culture of improvement, encouraging the construction industry to ensure an empowered knowledgeable and motivated workforce supported by committed management that can deliver the quality construction expected by the clients.

It can be seen that the delivery of projects to public-sector housing and schools, private-sector housing, and large public-sector infrastructure projects can be problematic due to the complexity of the projects, over-optimism in terms of the benefits and costs, and quality issues regarding the materials and techniques used, as well as the management of the design and construction process. The catastrophic failure seen in Grenfell Tower, the broader issue of UK buildings now enveloped with unsafe cladding, and the case of the Edinburgh schools are extreme examples that shine a troubling light on the UK construction industry which, along with the prevailing issues of delays and cost overruns in large complex projects, and the reduction in perceptions of satisfaction by new home owners, suggests that more can be done to improve the delivery, quality and safety of construction projects in the UK.

2.5 Construction project challenges

A project manager employs his/ her acquired knowledge, skills, and techniques to commence, plan, implement, observe, and finish projects based on the requirements specified by the client. With project management representing a more contemporary field, it has developed into an important facet of the construction domain since its introduction, becoming a horizontal approach featuring multiple disciplines while it engages in a broader operational function that enhances control, improves client relationships and offers increased profit (Medić et al., 2013; Burke and Barron, 2014). Nevertheless, regardless of the project manager's competency and training, a number of challenges exist in the context of managing construction projects that may cause the project to fail, be delayed, run over budget or be of poor quality (Schwalbe, 2015), which must be evaluated in terms of their importance, and addressed accordingly (Jato-Espino et al., 2014; Książek et al., 2015). These include the following issues:

- **Changing Scope:** Changing project scope can manifest due to the absence of specified goals and represents a significant reason for delays or overruns to be encountered in projects (Dumont et al., 1997). Ahsan and Gunawan (2010) asserted that an effective project manager has the ability to communicate concerns to enable assessment and to notify the stakeholders of changes, thus ensuring that they remain updated in terms of the schedule and budgetary changes that will arise, which is vital since change can be a primary cause for contractual disputes that can threaten the project's successful completion (McGeorge and Zou, 2012; Gharaee Moghaddam, 2013). Sudden changes in the market can result in project managers becoming reactive (Harrington et al., 2012), and can threaten the survival of the organisation (Strange and Vaughan, 1993).
- **Risk Management:** Risk management represents an important challenge in construction project management, due to the elevated threats and considerably increased expenses that may then arise; therefore, the project manager is responsible for identifying possible issues and strategies to overcome them (Loosemore et al., 2012). They must plan strategies to ensure that the project does not deviate, or it will undoubtedly be delayed or run over budget (Sousa et al., 2014), focusing on the planning and management of the myriad of activities required to complete the construction project successfully (Olander and Landin, 2005; Aized, 2012). Quality is threatened when changes to the project occur whilst it is underway (Leonard, 2010), which may require frequent adjustments to the design detail (Adetunji et al., 2003).
- **Stakeholder Management:** Gündüz et al. (2012) reported that since the lack of communication in a project can be fatal for the outcome, project managers require regular real-time information on the status of the project, as it is their responsibility to update their teams in terms of the requirements specified by the management and stakeholders, and to thus promote improved working relationships due to the more effective communication (Röyttä, 2016). In the context of construction project management, the project manager must promote free communication or incur a higher likelihood of threats arising from

communication-based issues (Meng, 2012). Love et al. (1998) underscored that construction is a particularly complex process, involving many different partners and interests, while Harrington et al. (2012) cautioned that construction project stakeholders can be characterised by confrontation, where they each focus on protecting their own interests during the project's lifespan (Pratt, 1995).

- **Unrealistic Expectations:** Challenges also arise in construction project management due to the unrealistic expectations of stakeholders, which can negatively impact on the team spirit and productivity, where the latter may fall if resources are lacking (Bhat and Rajashekhar, 2009) or deadlines are unfeasible (Lines et al., 2015). In some cases, the deadline will be missed regardless of the team's strong productivity, due to extensive feedback from the client and architect on the construction processes, and associated changes to the design and plan (Adetunji et al., 2003). Therefore, the project manager must make recommendations on behalf of the workers and counsel against unachievable expectations by establishing more feasible ones (Jarkas and Radosavljevic, 2012).
- **Stakeholder Indifference:** Stakeholder indifference in projects can also be fatal, with poor participation from stakeholders representing a frequent issue encountered in construction project management; when stakeholders convey indifference to the on-site activities, rework and delays can result (Mirza, 2010). To overcome this, it is vital for project managers to communicate with and encourage the stakeholders, although due to the challenges of getting stakeholders to participate, contingency plans must also be established (Li et al., 2015). In terms of the team spirit, this can be eroded by nominated sub-contractors' tendency to show greater loyalty to the architect who appointed them, as well as the distance that can exist between the contractors and designers (Adetunji et al., 2003).

Despite the challenges described above, inherent due to the great complexity of construction projects and the myriad of parties involved, through the project manager's ability to build, lead, motivate and inspire the project team, they create strong team performance that leads to the successful achievement of the project objectives (The Project Management Institute, 2017), thus underscoring the project manager's central role in achieving a successful project outcome. Every project manager has certain strategies that prove effective in their role, with highly effective project managers having previously encountered these challenges and thus developed strategies to avoid or reduce their effect, since fluctuations within the construction industry commonly occur (Leonard, 2010). The most important means of reducing challenges that manifest in construction project management is through the implementation of some form of QMS, since construction projects are typically described as lacking standards (Bawane, 2017), and inherently operate in an environment that is not closely monitored (Landin, 2000). This thesis proposes specifically the use of the ISO 9001 QMS (see section 3.4 for the discussion on QMSs), which is designed to support project managers in terms of reducing threats and challenges while enhancing quality, and thus can be an essential component of any manager's resources (Nolan, 2016), since through continuous improvement of the processes in the project, improved ISO 9001 QMS implementation will result (Chiarini, 2017; Hoyle, 2018).

2.6 Conclusion

This chapter explored the literature surrounding the UK construction industry and projects, in order to provide a foundation for this study in the UK context. The chapter began by establishing the characteristics of construction projects in terms of being temporary activities that lead to a unique outcome and involve a broad range of stakeholders. The emphasis then moved to the UK construction industry, with data presented on its important contribution to the UK economy and employment, as well as the efforts to improve performance through reports such as Latham's *Constructing the Team* and the more recent *Construction 2025* strategy that aims for efficiency targets in terms of construction and lifetime costs, and improved project delivery. The chapter also explored UK construction projects, presenting a range of research that has conducted investigations into project delivery, the parties involved, project management, and delivery to other sectors in general and in terms of quality. It was found that delays to project delivery are commonplace, due to issues such as traditional planning approaches, the complexity of the project, and optimism in terms of the benefits, schedule and costs of large infrastructure projects. The broad range of parties involved was considered, with qualities such as trust and strong communication found to be important characteristics required by the project management team in order to avoid conflict and the associated financial, schedule and relationship impacts. The role of the project manager was explored, and the broad range of skills, competencies and awareness required to fulfil their responsibilities. Then, the issue of project delivery to other sectors was addressed, with a number of cases and reports highlighted to demonstrate where industry improvements are still required. Finally, the challenges construction projects face in terms of changing scope, client expectations and relationships, and risk management were presented. With this foundation of the literature on the UK construction industry and projects established, the next chapter seeks to provide the theoretical foundation for the study in terms of quality management and the ISO 9001 QMS.

Chapter 3

Quality Management and ISO 9001

3.1 Introduction

This chapter provides an overview of quality in construction projects, followed by an exploration of the history and development of QMSs, where a range of systems are considered (e.g. Lean Management, Six Sigma, and Business Process Management). Then, the lens of focus is placed on the ISO family of standards, and ISO 9001 in particular, with the seven principles of quality management located in ISO 9001:2015 discussed. Next, the changes seen in the latest 2015 edition of ISO 9001 are explored to exemplify how the QMS is in a constant state of development, while the specific benefits of ISO 9001 are considered, as well as the role of ISO in procurement. However, ISO 9001 implementation is not necessarily a straightforward process, and thus the challenges to its effective implementation are explored since it is vital to understand where issues may present and attention may be required. The chapter then moves towards its conclusion, where the provisional critical success factors for the effective implementation of ISO 9001 in construction projects are drawn from the aforementioned literature, to enable this research to proceed to the development of a methodology and later, data collection activities.

3.2 Quality in construction projects

One of the key competitiveness components of the construction industry is quality, which can be defined as achieving or exceeding the client's requirements and expectations, and thus ensuring that the client is satisfied with the outcome (Juran, 1999a). Crosby (1979) described quality as the successful conformance to a set of specifications or requirements. Deming asserted that quality is the extent that dependability and uniformity can be predicted at a reasonable cost and being suitable for the intended market (Mukherjee, 2019). Although the objective of quality is increased client satisfaction and potentially increased income as a result, higher quality levels typically require greater investment, and therefore higher quality usually leads to increased costs (Juran, 1999a). Quality has a direct relationship with meeting the specifications stipulated in the contract, the completion of the project on time, meeting the client's requirements within the budget and the avoidance of disputes (Ning et al., 2011; Jraisat et al., 2016; Proverbs et al., 2018). Nevertheless, some clients' needs can be challenging to express clearly, and if they are not fully met, this may compromise the potential for a satisfactory project outcome (Hoyle, 2018). Therefore, clients and contractors often look to harness the strength of a QMS to ensure the effective implementation of quality standards (Mukherjee, 2019) and promote satisfactory outcomes. The management of quality is thus a vital role of project management. Regarding the project's growth and continued performance improvement, this is heavily reliant upon ensuring appropriate quality management mechanisms. The project's quality is not only linked to the budget and time, but also to the requirements for quality and specification. As reported by Project Management for Development Organizations (2008), the management of quality in a project entails processes to ensure that those requirements that are defined and planned will be achieved, namely the processes for assurance, control, and quality planning. The management of quality in a project involves all those management-related activities that promote quality in terms of the objectives, policy and obligations, and ensures that they are fulfilled by planning and quality improvement through the assurance of quality and control. Figure 3.1 specifies the processes of projects in the quality management context.

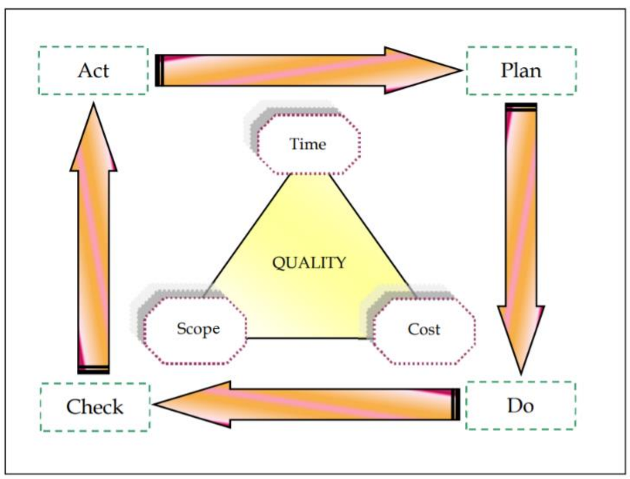

Figure 3.1: The quality management of projects (Anişor and Ion, 2010)

Similarly, Rumane (2013) referred to quality in construction as being governed by the Defined Scope–Schedule–Budget components, which he coined the 'Construction Project Trilogy', whereby construction quality is achieved by meeting the client's requirements as per the prescribed scope of work, while remaining within the scheduled timescale and the agreed budget. He continued by underscoring the importance of the participation and engagement of the client, the designer (architect) and the construction company in order to develop a quality system and then implement the necessary techniques and tools (Rumane, 2013) to ensure its effective implementation. The management of project quality entails the processes necessary to assure that the project meets the beneficiary's expectations and needs in terms of identifying the respective levels of quality for the project and how these can be met, planning for a quality system that is implemented to locate the project within the quality planning parameters, monitoring the outcomes of the project's activities and evaluating their standards of quality, exploring opportunities to remove the reasons for unsatisfactory outcomes, and promoting continued improvement (Anişor and Ion, 2010).

The management of quality in construction differs from the manufacturing domain since the construction sector involves not only the quality of the products and equipment utilised during the construction process, but also the management of the entire project to ensure a satisfactory outcome in terms of project completion to the client's satisfaction while meeting the defined purpose (Rumane, 2018). Moreover, construction projects are unique, non-repetitive undertakings, as opposed to recurring manufacturing process that can be established, refined and duplicated (Rumane, 2018). Quality management is achieved through a number of vectors:

- **Management:** Through the implementation of a QMS grounded in the quality management principles (QMPs) established, such as within ISO 9001, which is client focused, constantly analysed, and led through purposeful and strategic leadership (Abuhav, 2017).
- **Product:** The product's quality is decided through a range of processes, including the material and labour input required to ensure a satisfactory outcome, whereby monitoring is conducted on the output at various stages of the production, and any non-conformity is identified and addressed (i.e. repaired, reworked, or discarded), with measures taken to prevent the problems from re-occurring (Rumane, 2018). However, since ISO 9001 does not stipulate quality specifications or requirements for products, these should be stipulated by the client or the providing organisation via contractual agreements, product standards and technical specifications, for example (Mukherjee, 2019).
- **Processes:** Quality is delivered in processes through ensuring that (i) the intended outputs of processes are clear, identified and can be measured; (ii) those responsible for the outputs are known; and (iii) those who conduct the processes are aware of what outputs are expected and have the criteria, knowledge, and means to verify that the outputs are indeed as expected (Abuhav, 2017).

- **Service:** Zeithami et al. (1900, cited in Hoyle, 2018) identified five characteristics that can be useful to define service quality: (i) reliability, where the service can be performed accurately and reliably; (ii) assurance, in terms of the staff's knowledge, behaviour, and the extent to which they are able to convey trust and confidence; (iii) tangibles, via the appearance of the equipment, facilities, and personnel; (iv) empathy, through offering personalised and sensitive attention to clients; and (v) responsiveness, by demonstrating a willingness to assist clients and offer a timely service.
- **Site:** On the site itself, quality is delivered through (i) the inspection of work currently in progress, (ii) the inspection and approval of materials that are delivered to the site, and (iii) either the acceptance or the halting of the work in progress (Rumane, 2018).
- **Quality:** Based on the Plan, Do, Check, Act ([PDCA]; see Figure 3.1) approach, the ISO 9001:2015 QMS enables (i) the top management to lay down the quality policy, with quality objectives selected and performance indicators established (Plan); (ii) the implementation of production and service processes to assure that the client's needs are achieved (Do); (iii) the monitoring and auditing of the QMS to measure performance versus the client's requirements and the organisational objectives (Check); and (iv) the initiation of actions to address issues and enhance quality performance (Act) (Dentch, 2016).

As described above, the management of quality represents an ongoing process beginning and concluding with the project and located within all the processes of project management spanning from the project's commencement until the closing stages of its completion. Therefore, in this study and in accordance with the inherent importance of quality in terms of a successful project outcome, the focus of this thesis will be placed on identifying the challenges facing the effective application of quality in construction projects in order to determine the critical success factors. To achieve this, a detailed review of the literature is pursued in this chapter.

3.3 Quality management system overview

Quality management is the mechanism through which the consistency of a product, service or organisation is achieved; the four primary components are quality assurance, control, improvement, and planning (Rose, 2015). Since the focus extends beyond the quality of products and services, to include how this can be achieved, quality management also considers processes in the quest for enhanced quality. Ingason (2015) described the emerging relationship amongst the project management and quality management disciplines, whereby the former was typically linked with the notion of temporary organisations, whereas quality management was more closely associated with permanent organisations; however, more recently the project management tendency is for organisations to adopt process approaches, that is, quality management is being utilised in their project management. Alongside other processes, Dumitrascu and Nedelcu (2012) underscored that quality management represents a vital element of project management, whereby for a project to grow and continually improve in terms of its performance, the effective management of quality is vital in regard to not only the budget and time, but also the quality requirements and specifications. Nevertheless, the key principles of quality management (i.e. control, no defects, and process orientation) have been criticised as being unobtainable, whereby the complex nature of management cannot be merely determined as procedures that are standardised (Warzecha, 2017). Ismyrlis et al. (2015) explored the level of importance and implementation of critical success factors in Greek ISO 9001-certified companies through a questionnaire survey of 113 organisations, where they found that the managers of quality assurance in these companies placed strong importance on the critical success factors, although the implementation of some (e.g. communication, education, and management commitment) was higher than others (e.g. making data available and ensuring the utilisation of statistics).

Representing one of the key drivers resulting in the growth of organisations and their successful engagement in construction markets both internationally and nationally, a QMS is vital to ensure that construction companies offer their clients products with added value at a consistently high quality (Neyestani and Juanzon, 2016). Accordingly, a particularly challenging issue for the departments of industrial and service organisations in the modern era is the means and speed of responding to clients' requests to ensure improved products and services, whereby a QMS is often introduced to help meet these demands (Foss and Deceuster, 2017). Over the last three decades, the QMS has become the central focus of organisations throughout the developed and parts of the developing world. The notion of quality in the modern era not only involves products and services, but also includes the functions from a design, productive, and organisational perspective that may be linked to them, together with those who are involved in these processes (Keng and Kamil, 2016). Representing a philosophy for management that entails all quality facets of interest to the client and the organisation, the QMS approach in the global context has been viewed as a credible means of cost reduction and enhancing productivity, while promoting improved quality (Criado and Calvo-Mora, 2009).

The construction industry's ability to realise levels of quality that are deemed acceptable has been an ongoing challenge, with significant amounts of capital, resources and time expended annually due to quality management procedures that are either inefficient or non-existent (Proverbs et al., 2018). The manufacturing industry that successfully developed QMS concepts that were first applied in Japan and then later in the United States (US), has resulted in a range of positive outcomes that include enhanced productivity, reduced costs and highly reliable products. However, the management of quality in construction projects differs from that employed in the manufacturing sector, since construction projects not only require quality in terms of the materials and equipment utilised, but also for the management of the project to meet the client's needs and ensure their satisfaction, while achieving completion on time and within the cost parameters (Rumane, 2018). In the next section, the literature regarding the history and development of QMSs will be reviewed.

3.3.1 The history and development of QMSs

The emphasis on enhancing quality through the reduction in variation is a clear quality management contribution, from ensuring regular-shaped stones to aid in the construction of ancient temples, to manufacturing car doors that close with precision and keep out the elements, with customers in the modern era having expectations of such precision and accuracy (Best and Neuhauser, 2006). The Industrial Revolution, which originated in the UK in the early nineteenth century, was an important historical milestone that saw the growth of mechanisation spreading throughout Europe and the wider world, while introducing the notion of labour specialisation in the workforce. The first factories were established in the US and Europe, impacting on the traditional craft production model (Kolb and Hoover, 2012). Post-Industrial Revolution, everything changed. The American engineer Frederick W. Taylor (1856–1915) introduced the term 'scientific management' that divided organisations into directors and engineers responsible for planning, and supervisors and employees responsible for implementation. Taylor aimed to raise production and productivity through the enhanced planning of manufacturing by creating a division between the planning (carried out by engineers) and the implementation of the plans (carried out by the workmen and supervisors), with his system proving incredibly successful in terms of increasing productivity and thus being broadly implemented in the US (Juran, 1999a). From his managerial and consultancy experience, Taylor forwarded a modernised management approach, whereby (i) rather than based on the judgement of supervisors or workmen, the methods for conducting work should be developed from scientific study; (ii) such scientific study should also be utilised to determine what comprises a day's work and how workmen should be selected and trained; and (iii) payment based on the work completed should be adopted to increase the workmen's motivation to embrace the proposed methods and satisfy the requirements of a day's work (Juran, 1973). Nevertheless, despite the enhanced productivity that resulted from Taylor's system, there was a negative impact on quality, which companies attempted to address by an increase in the inspection of products that prevented customers from being exposed to faulty products, but significantly increased the levels of waste that were generated (Juran, 1999b). Quality thus developed into an important issue, with production deadlines the main priority of the production manager. The quality control department was increasingly responsible for quality, with inspection representing the primary measure during the 1900–1950 period.

Henry Ford (1863–1947) also impacted on the evolution of the quality system by establishing a modern production line (Evans and Lindsay, 2013). Ford is broadly viewed as the architect of quality together with mass production, where he was responsible for the design of vehicles that were reliable and could be manufactured quickly, systematically, and cheaply by workers who were not masters of their trade, thus enabling everyday American households to purchase a car due to the reduced purchase cost (Ishizake, 1999). A new model for data collection, presentation, and analysis was introduced by Walter Shewhart (1891–1967) in 1924 that featured the first known process control schema and signposted the onset of the statistical quality control/ statistical process control era. US military forces began to use the Shewhart model to control statistical operations. Also referred to the Shewhart cycle, the Deming cycle, and the Plan–Do–Study–Act cycle (see Figure 3.1), the model has four phases: (i) Plan, in order to establish what change is necessary and what can be improved; (ii) Do, to carry out the implementation of this change; (iii) Study, to examine the outcome or process analytically; and (iv) Act, in the case of unintended results (Best and Neuhauser, 2006). Juran and Godfrey (1999) described statistical process control as the (i) collection of data, (ii) analysis of such via tools that include the Shewhart control chart and frequency distribution, and then (iii) applying the process capability concept. Shewhart understood that data could be drawn from industrial processes, which could be statistically analysed in order to determine whether those processes were stable, or whether they were being affected by certain causes that should be addressed. Through this, Shewhart was responsible for the introduction of control charts, which were utilised to control and monitor for variations in the quality of products (Mukherjee, 2019), with the development of these control charts claimed to be one of the most vital developments in the management domain (Best and Neuhauser, 2006). Shewhart spent the entirety of his professional career with the Western Electrical Company (1918–1924), before joining Bell Laboratories as a technical staff member in 1925, until he retired in 1956 (Deming, 1968).

Walter E. Deming (1900–1993), who worked as a statistician with the Department of Agriculture and Census Bureau in the US, was described by Rumane (2018) as the 'founding father' of the quality field, with his philosophy being grounded in (i) the PDCA cycle (see Figure 3.1), which is an iterative process for achieving change on a continuous basis; (ii) statistical process control, which was developed from Shewhart's earlier work and represents a quantitative approach that is grounded in measuring the control of processes; (iii) his 14 transformation principles, whereby extended commitment to the acquisition of novel philosophies and learning are necessary for management that aim to undergo transformation; and (iv) his 7-point action plan, which includes management taking bold steps forward, clearly explaining the change to the staff members, encouraging teamwork, and developing a quality-focused organisation (Farooqui and Ahmed, 2009b; Rumane, 2018). In Deming's view, management are definitively responsible for poor product quality and productivity, while conversely quality leadership is one of the keys for enhanced product and service quality (Nelson, 2006). Deming and Joseph M. Juran (1922–2014), who were taught by Shewhart, were both identified and engaged by the US Department of Defense in order to train civilian suppliers during World War II in terms of improved quality and efficiency (Chukwulozie et al., 2018), with the Department requesting that its suppliers employ statistical process control and conform to US military standards (Edvardsson and Gustafsson, 1999).

Post-World War II, the US sent Deming and Juran as advisers to help rebuild Japan, since they were viewed as being more influential in terms of quality development. Deming's first visit to Japan was in 1946, where he was the US Department of War's Economic and Scientific Section representative and became fundamental to the improvements in Japan's industrial sector through his engagement with the major leaders and industrialists (Mukherjee, 2019). The message delivered by Deming and Joran in terms of how Japanese industry could be regenerated can be summarised through four statements: (i) since the survival of a company is absolutely tied to the management of quality, there is an unarguable rationale for the complete focus and commitment of the senior management; (ii) due to the challenges of ensuring quality through control, the major responsibility for ensuring quality has to be placed on the shoulders of those who carry out the work; (iii) the management must develop systems so that work can be both controlled and verified, and then train the workforce in how these systems are applied; and (iv) since the benefits of improved quality include reduced waste, increased output, enhanced product quality and increased profits, the costs incurred through skills and training should not be a concern (Rumane, 2018). The broadly accepted approach of the reliance on inspection was broken by the post-World War II quality revolution in Japan, which led to a significant reduction in generated waste, enhanced product characteristics, and the elevation of Japan to the status of a key economic player on the global stage (Juran, 1999b). There was a significant intensification of competition for quality at the international level, which increased to worrying levels in Western nations and peaked during the 1980s (Juran, 1999b).

In 1950, the Union of Japanese Scientists and Engineers invited Juran to come to Japan to give conferences to senior and mid-level executives. Mukherjee (2019) asserted that there is some fundamental agreement between Deming and Juran, but while the former places the lens of focus on the methods and principles, Juran emphasises the results, with the belief held that everyone from the top manager to the worker on the ground are collectively responsible for quality. Juran claimed that a 'quality breakthrough' is necessary in order to considerably decrease the volume of waste produced while attaining a new level where quality can be maintained, asserting that such a breakthrough requires the progression through a number of phases: (i) evidence of the need, (ii) identifying the project, (iii) the organisation for improvement, (iv) diagnosing the issue(s) and solution(s), (v) carrying out remedial activities, (vi) overcoming the resistance to change from a cultural perspective, and (vii) maintaining the improvements (Mukherjee, 2019).

The notion of quality control has been extended to represent continuous improvement across the organisation and is no longer viewed as being primarily a corrective process (Hellman and Liu, 2013). More recently, the notion of quality has evolved from being very narrowly to more comprehensively defined. The pathway to quality originally began with inspections, followed by quality control in the 1930s, where a shift occurred from the quality of the product to the quality of the process. The notion of quality assurance was established in the 1950s as organisational quality emerged. Subsequently, in 1949, Total Quality Management (TQM) was created through the Union of Japanese Scientists and Engineers' formation of a committee of engineers, government officials and scientists dedicated to increasing the productivity in Japan, promoting the post-war quality of life, where around 1980 American companies started to seriously perceive TQM (Lewis and Slack, 2003). The values focus on continuous improvement, empowerment, caring for people, and participation, as opposed to conforming to specifications and imposing blame if there is no change from the norm. Therefore, Youssef (2006) reported that quality has travelled through four eras: inspection, control, quality assurance, and strategic management.

According to Juran (1999a), the realisation of quality is achieved through management processes, namely a sequence of activities that lead to the desired outcomes, which entails the considerable use of quality control, quality improvement and quality planning, also referred to as the 'Juran Trilogy'. A particularly challenging problem that confronts the departments of industrial and service organisations in the modern era is the ways and speed of responding to customers' requests to enhance the product or service. Here, the role of quality management must meet these demands. Schiffauerova and Thomson (2006) indicated that companies commonly underscore quality as being central to client value, while considering it to represent a critical success factor in terms of achieving competitiveness. Feigenbaum (1983) defined quality as the extent that when put into use, the product conforms to the client's expectations, while Crosby and Free (1979) simply defined quality as conforming to the specified requirements. The American Society for Quality adopted Feigenbaum's (1983) understanding of quality as the definition in their organisation, essentially that quality is based on the client's view. Initially, commencing with the work conducted by Deming and Juran, the primary focus was placed on quality control applied to the production processes, thus ensuring the final product's quality, as experienced by the client. When considering how to advance quality, it became apparent that all activities carried out by the organisation must be coordinated and integrated. Quality is the outcome of the interaction of a range of organisational processes, as indicated by the notion of total quality control. Djerdjour and Patel (2000) claimed that quality must be viewed as a mandatory factor, since it represents a key survival strategy. It should be underscored that the primary theme in all these definitions is meeting the client's expectations and needs. Therefore, it is vital that such needs be identified by companies at an early stage in the cycle of service or product development. In the later definitions of quality, focus was placed on client satisfaction and generating loyalty, with Dale (2003) highlighting the regularly employed definition of quality that describes fully satisfying the client by comprehensively meeting their expectations and needs. Since the definitions cited above may include attributes of quality that include appearance, availability, cost effectiveness, delivery, maintainability, performance, reliability, and price, it is imperative that the organisation identifies these needs and expectations. The organisation must comprehend its clients and deploy measurements and plans to meet their needs; thus, quality must be the responsibility of all involved. It should be the focus of all individuals, for all activities, in all departments, and represent a practice for improvement that is carried out on a daily basis, so that the organisation engages with quality (Dale, 2003).

According to Knowles (2011), the notion of dynamism implies that acceptable quality standards can shift depending on the client's world view and experiences, as opposed to being fixed. Essentially, the client defines quality, and therefore this will change over time, often unpredictably. From here the role of quality management emerges. Knowles (2011) found that if quality represents the outcome, then quality management reflects the approach and process for arriving at that point. Accordingly, organisations need to develop process management and leadership. Quality management must be a strategic undertaking inside the organisation. Hence, research has been carried out to develop quality management within organisations. Many tools have been developed to deliver TQM, while ISO 9001 in its 2015 edition was intended to represent a shift towards TQM through recognition of environments that have increasingly become more dynamic, complex and demanding (Fonseca, 2015). Jammal et al. (2015) defined TQM as a tool for management to continuously improve the internal and external functions and processes of an organisation in order to attain client satisfaction, with Six Sigma and Lean Management defined by Chugani et al. (2017) as quality management methods. These tools are often used together, in which case they are referred to as 'Lean Six Sigma'. Lean Management primarily focuses on the reduction of waste and highlighting activities that fail to add product or service value, while Six Sigma identifies errors, defects, or failures that may negatively impact on the processes (see section 3.3.1.2). Others tools include the ISO's QMS, established in 1987 by an official international organisation that provides standards and certificates in the field of quality and has since become recognised by many governments internationally as a certificate that determines the extent to which institutions apply the quality system, as will be discussed in detail in the next sections. Figure 3.2 describes the evolution of quality, from the focus on operatives and foremen in the early twentieth century, towards greater inspection and structure in the mid-twentieth century, and then a shift towards full quality control and management by the end of the century.

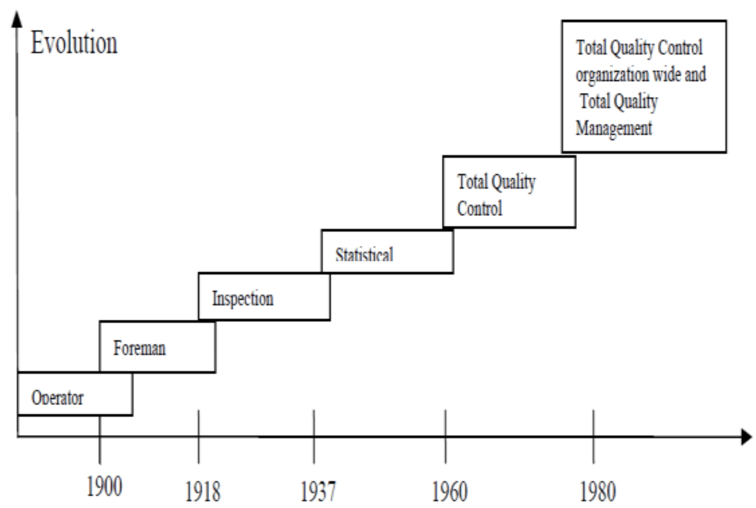

Figure 3.2: The historical evolution of quality methods (Bhoyar et al., 2017)

Whilst quality management can be implemented by any organisation to improve and manage the processes, many international organisations, including construction companies, have attempted to employ a number of quality systems to develop their operations and enhance client satisfaction. A selection of these are discussed below that include Six Sigma, Lean Management, and TQM, as well as other QMSs utilised in construction, manufacturing and other sectors.

3.3.1.1 Total Quality Management

The competitivity, effectiveness, efficiency and flexibility of an organisation can be improved through TQM in terms of ensuring that the client's requirements are satisfied (Alotaibi et al., 2013). It involves processes that recognise the importance of determining the clients' requirements and employs that awareness to propel the whole organisation towards ensuring that those needs are fulfilled (Uduk, 2015). The Japanese developed TQC (or Total Quality Control), which was then imported by the US to contribute towards its industrial resurgence; it was subsequently referred to by Western nations as TQM, with Japan also following this change to agree with the practice, now accepted internationally (Aljuboury, 2011). The concept of TQM originated from the manufacturing industry; therefore, the majority of the literature addresses this industry (Harrington, 2012). Ensuring the satisfaction of clients represents one of the key principles of TQM, in itself an important organisational aim (Harrington et al., 2012). Nevertheless, the implementation of TQM may differ between industries. For example, the manufacturing industry differs from its industrial counterpart in a manner whereby TQM's introduction becomes more challenging, since while the former is characterised by fixed processes, the latter features unique processes (Antunes and Gonzalez, 2015). In the late 1980s, the construction industry in the US started to show interest in TQM, although it was argued that TQM would not be appropriate in the US construction sector; however, some years later, many US construction industry actors had implemented TQM, as well as certain other Western countries such as the UK (Mahbashi, 2007).

Every implementation process encounters different challenges, obstacles or a flawed approach to TQM. As human error plays a significant part in the implementation of TQM, the most frequent reasons for failure include the lack of management commitment (Al-Ali, 2014), while according to Mosadeghrad (2014) there are both theoretical and practical difficulties in terms of applying TQM. An ineffective package, inappropriate implementation methods and an inappropriate implementation environment are the main reasons for TQM failure. Moreover, Nicolaou and Kentas (2017) indicated that as the TQM approach does not apply a specific framework, the organisational management must communicate and explain the stages of the framework to ensure that the required objectives are realised, and where these stages are opaque, management must intervene. Cultural change represents TQM implementation's most challenging and slowest stage, with the same problem being faced by the ISO system when applied in construction projects. This results from employees experiencing fear and thus resisting change, while those with a traditional culture will experience greater difficulties in altering their daily tasks than those employees with a culture that is oriented towards quality (Jafari and Setak, 2010). The TQM approach is a long-term journey, and thus adequate time must be allowed for implementation. TQM's basic principles require time to allow the employees to adopt them (Siddiqui et al., 2012). According to Westcott (2013), quick solutions are not feasible through TQM, with successful implementation requiring sufficient time. However, quick solutions are construction projects' most important characteristics.

Loushine et al. (2006) highlighted that criticism has been levelled at the construction industry due to its unsatisfactory performance and productivity when compared with different industries, while a considerable number of the management practices applied in the context of construction projects are being questioned. With clients continually demanding enhanced quality, faster completion and technological innovation, it is thus unsurprising that the construction industry has reached out to the manufacturing sector as a reference point and innovation source, exploring successful theories and practices emerging from the manufacturing sector such as TQM or Lean Management, which the construction industry is now adopting and integrating (Maher Altayeb and Bashir Alhasanat, 2014). Specifically, cooperation and teamwork at the organisational level (both inter and intra) are vital to ensure that these concepts are successfully implemented, where construction companies have adopted quality management as a mechanism for resolving issues of quality and to assure that the client's needs are being met. Nevertheless, the implementation in construction projects of the principles of TQM is particularly challenging due to the absence of standardisation, as well as the numerous involved parties (Harrington et al., 2012).

3.3.1.2 Lean Management and Six Sigma

Fernández-Solís and Gadhok (2018) defined Six Sigma as a theoretical statistical technique aimed at assisting in project design and implementation, delivering accelerated business results through reduced time, waste, and cost; moreover, it represents a methodology for removing process defects that is disciplined and based on data. The Six Sigma concept was created by Motorola in the 1980s to reduce the number of defects in manufactured components to 3.4 defects per million (Godfrey, 1999). The levels of sigma are associated with improvements; for example, achieving Three Sigma would indicate 66,811 defects per million, while Five Sigma would mean 223 defects (Rumane, 2018). The stages involved are to Define (What is important?), Measure (How are we doing?), Analyse (What is wrong?), Improve (What needs to be done?) and Control (How can we guarantee performance?) (DMAIC) (Godfrey, 1999; Rumane, 2018), whereby a product is produced or a service is carried out identically each time (Rumane, 2018). The Six Sigma methodology involves (i) comprehending the client's requirements, (ii) ensuring the business processes are aligned to meet these requirements, (iii) using data to minimise variation, (iv) ensuring continuous improvement in the business processes, and (v) conducting the above in a timely manner (Rumane, 2018). This data-driven nature refers to the practice of measuring everything in order to logically identify an otherwise obscured wasteful practice, while the main principle of Lean Management is to deliver greater value through the identification and elimination of embedded material or process waste. Lean Six Sigma (LSS) has developed into a model for business with the goal of eliminating waste and has shown its considerable value and potential in terms of modifying the organisational culture and the vision of employees in respect to the developments that manifest within the company (Pamfilie et al., 2012). According to Syahputri et al. (2018), Lean Management can be described as an approach to achieve the identification and reduction of waste through the systematic and ongoing improvement of the product in an attempt to achieve perfection in the eye of the customer. Six Sigma can be described as a business process enabling companies to significantly increase their profits through the design and monitoring of daily business actions to minimise the production of waste and resource usage, while simultaneously enhancing client satisfaction (Andersson et al., 2006). A trend is prevailing in terms of the LSS integration, by including Six Sigma projects in their Lean Management counterparts, resulting in LSS (Pepper and Spedding, 2010). Both represent vital process strategies that can be utilised to increase companies' performance in terms of manufacturing (Thomas et al., 2008). In the context of the manufacturing sector, Figure 3.3 illustrates an integrated Lean Six Sigma model, comprising a combination of the LSS concepts with the DMAIC method (Syahputri et al., 2018). The DMAIC method is primarily employed to reduce the costs of a process, product or service through digital improvements, and thus it is driven by data in order to highlight potential efficiencies (Rumane, 2018). When the approaches are combined, process defects and waste are reduced, while cultural change can occur in the organisation (Summers, 2011).

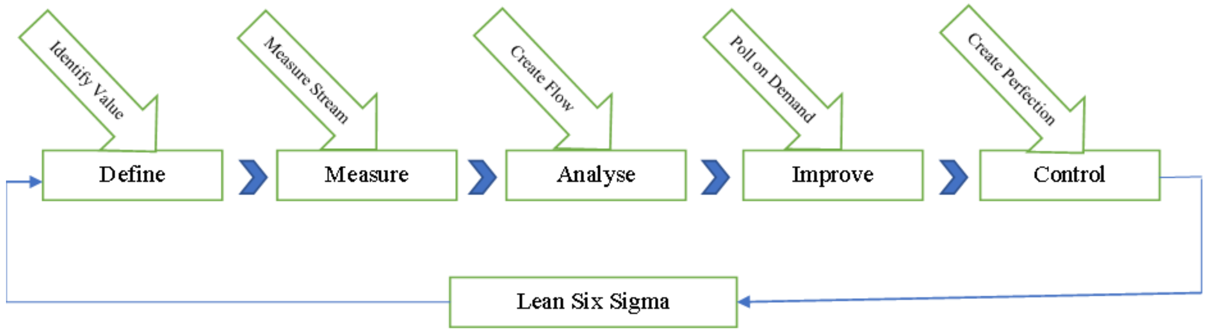

Figure 3.3: The LSS model merged with the DMAIC method (Syahputri et al., 2018)

Six Sigma's implementation is carried out by employing the DMAIC approach, describing the production-process flow for the current condition and post-improvement through applying value-stream mapping, which represents a means of presenting the information and material flows. Moreover, value-stream mapping enables all activities to be identified from the instant that the customer places the order until the point of final delivery, while also highlighting activities that add value and those that add no value. Where the latter exist and are not vital for the company's operation, such activities adding no value must cease.

LSS reflects a methodology for improving a business that integrates two philosophies for management, with the mutually complementing Lean Management and Six Sigma serving to enhance the project management processes by reducing non-productive time and other waste (Pepper and Spedding, 2010). Dakhli et al. (2016) indicated that some of the elements of variability in construction projects are the late delivery of material and equipment, design errors, changed orders, malfunctioning equipment, faulty tools, poor utilisation of personnel, strikes, environmental effects, ineffectively designed production systems, accidents, and the physical demands of work. Lean Management and Six Sigma attempt to address these through managerial and production processes that have integrated approaches and place their emphasis primarily on eliminating waste. However, Fernández-Solís and Gadhok (2018) explained that both paradigms face similar challenges that can only be overcome if the two systems are merged, since the two models have the potential to become a significant tool if combined. This will allow a substantial advantage regarding the improvement of the construction process by achieving combined benefits through the utilisation of principles from both strategies. For example, if Six Sigma is implemented without Lean Management then the system would lack the structure and tools to drive the process towards high value and waste reduction. Perhaps the most common mischaracterisation of Six Sigma is that it is essentially TQM, and that Six Sigma is merely an extension of the existing notion of statistical quality control (Abdelhamid, 2019).

3.3.1.3 European Foundation for Quality Management

The European Foundation for Quality Management (EFQM) excellence model supports organisations in their endeavours to successfully manage quality whilst ensuring that they operate in a sustainable manner and thus become more competitive. The EFQM model is built upon nine primary dimensions, categorised into input criteria: (i) leadership, (ii) policy and strategy, (iii) people, (iv) partnership and resources, and (v) processes; and output results emerging from (vi) clients, (vii) employees, (viii) society, and (xi) key performance (Uygur and Sümerli, 2013). The core concepts of the EFQM model are oriented towards results, whereby the focus is on the importance of the satisfaction and loyalty of clients as one of the main stakeholders; leadership motivation and strategic processes, which focus on quality, the partnerships between stakeholders, and sustainability; employees as another main stakeholder, through their contribution to competitiveness, improvement, and innovation; and the long-term partnerships with stakeholders as a component of organisations' social responsibility (Gorenak, 2015). Gorenak (2015) reported that while there may be differences between the implementation of ISO 9000 and EFQM, whereby some organisations have a tendency to implement ISO 9000 initially and then introduce the EFQM model later due to resource limitations, it is ideal to apply them both simultaneously as an ongoing process where ISO 9000 addresses quality standards on a day-to-day basis, while the EFQM model has a more long-term orientation.

3.3.1.4 Building Information Modelling

BIM is an innovative approach that generates a digital database to collaborate and manage building-related data over a building's lifecycle that enables the data to be stored and applied to construction industry applications, while also facilitating the staging of project planning and coordinating during the project lifecycle (Rumane, 2018). Development and maintenance of the BIM standards is carried out by ISO/TC 59/SC 13 (an ISO subcommittee) and CEN/TC 442 (a European Committee for Standardisation technical committee), who liaise with a myriad of institutions to assure that the processing and acceptance of the standards is complete, inclusive, and smooth (Poljanšek, 2017). BIM has been utilised in construction projects to enable the final project to be digitally constructed before any physical construction takes place, thus facilitating in the reduction of uncertainty, the improvement of safety, the advance resolution of problems, and the simulation and analysis of potential impacts (Lee et al., 2014). In their paper focusing on the use of BIM for the integration of quality information in road and bridge construction, Lee et al. (2014) found that BIM can enhance the efficiency of construction while improving the quality control process in terms of the accuracy. Poljanšek (2017) reported that BIM will enhance the coordination of construction projects as well as the certainty of the output, inclusive of increased quality and a reduction in the number of defects. While the requirements for BIM can be implemented separately, there is increasing interest in adding the processes of BIM to the ISO 9001 QMS and realising the aforementioned data-modelling benefits, as well as reduced construction waste, better meeting of the client's needs, and reducing the lifecycle costs of the building, whereby many construction companies in the UK have been working towards the British Government's BIM Level 2 compliance, which will enable them to tender for publicly financed projects (Newforma, 2015).

3.3.1.5 Business Process Management

According to Hammer (2014), Business Process Management (BPM) comprises of a complete system that helps to manage and transform the operations of organisations, based on what he claims to be perhaps the first new set of ideas in the context of organisational performance that have emerged in the post-Industrial Revolution era. BPM has demonstrated a successful record in terms of helping organisations to innovate and improve, with its application expanding in context and scope, although vom Brocke et al. (2016) cautioned that the majority of BPM models suggest a generic approach, which can represent a threat as the circumstances of each project will differ. Rosemann and van Broke (2014) developed a framework of the vital elements of BPM, drawn from the field of BPM research and its application in organisations globally, where they defined six core components: (i) culture, (ii) governance, (iii) information technology, (iv) methods, (v) people, and (vi) strategic alignment. Abuhav (2017) asserted that BPM experience should be sought when seeking someone to fill the process approach role in the ISO 9001:2015 QMS due to the transferrable skills that can be exploited. Nevertheless, it is claimed that there are clear differences between BIM and ISO, where the former more effectively addresses the dynamic organisational elements through its focus on active flows such as the cultural aspects, the organisational values, and universal practices, as opposed to ISO's drive towards ensuring the comprehensive documentation of all processes to ensure their maturity (Breyfogle, 2015).

3.3.1.6 Business Process Reengineering

In order to remain competitive in the modern era, where it is not simply sufficient to cut costs, but more comprehensive changes are necessary through analysing and designing the processes and workflows within and between organisations, Business Process Reengineering (BPR) emerged in the 1990s as a means of targeting (i) enhanced client focus, (ii) improved effectiveness of the product or service being produced, and (iii) improved efficiency of the product or service both at the production and the management levels (Razalli et al., 2017). Nevertheless, Dentch (2016) asserted that while BPR has had its successes, one of its weaknesses is its top-down approach that dictates the changes to middle-management rather ensuring that senior *and* mid-level management are committed to the implementation and support of the new approach. Razalli et al. (2017) described the key dimensions of BPR as change management, client focus, commitment of management, investment in IT, redesign of processes, reducing the bureaucracy of the organisational structure, strategic alignment, and ensuring the availability of sufficient financial resource.

3.3.1.7 PMBOK and PRINCE2

In terms of international acceptance, the Project Management Book of Knowledge (PMBOK) and Projects IN Controlled Environments2 (PRINCE2) represent the most commonly applied standards. Developed by the Project Management Institute, PMBOK is an international standard for the management of projects, where the fifth edition involves the application of knowledge, skills, techniques and tools in project activities in order to fulfil the requirements of the project; while PRINCE2 is a project management approach that is process-oriented and the most common project management approach used in Europe (Huda et al., 2018). PMBOK's process model places its focus on inputs (e.g. the quality policy, the project scope and standards), tools, and outputs (e.g. the quality management plan and the identification of suitable measurements); while PRINCE2 addresses quality through quality assurance, quality control, quality management, and quality planning, which starts with the client's expectations and then leads on to the development of a quality log that is verified periodically throughout the project (Nelson, 2006). Brioso (2015) asserted the compatibility of the PMBOK and PRINCE2 methodologies due to the lack of conflict with enhanced flexibility, encouraging the utilisation of the best techniques and tools available.

Having considered a range of quality systems in this section, including their strengths and characteristics, the subsequent section now considers the ISO QMS, and pertains why it is the focus of this study.

3.4 The ISO QMS

The International Organization for Standardization (ISO) QMS includes processes, structures, procedures, and resources through which quality management is achieved. Creating such a system represents a way to ensure that the processes developed within the organisation are capable of meeting certain requirements. Each organisation performs activities regarding quality, and therefore it can be said that they have a quality system, whether formalised or not. Interest in quality began during World War II, where companies in various industries incorporated quality systems in their own activities and established rules that their suppliers complied with. The effect of this movement was that different rules on quality were established: each organisation required its suppliers to follow the established rules and to check them to ensure they followed the requirements. This situation was perpetuated for decades, creating barriers to the exchange of goods and services. Therefore, it became necessary to introduce common standards that simplified the task of suppliers to meet the customer's requirements, which is what the ISO has achieved. As described by Sousa-Poza et al. (2009), in 1947 in Geneva, the ISO organisation was developed to enable the technical specifications for internationally traded products to be standardised, and in 1987 the ISO commenced a technical committee (the ISO/TC 176) with twenty-member nations and an additional fourteen nations comprising observing members, thus creating the first family of standards. ISO is, therefore, an international organisation, populated by members from a range of national standards' bodies, and which is responsible for international standards. The ISO's QMS is compatible with other QMSs, including methods/tools such as British Standards, Lean Management, Six Sigma, Statistical Process Control and TQM (Project Management Institute, 2008). Aized (2012) reported that the ISO QMS is a systematic approach, documentation, direction, and review applicable to each process of organisational management extending from the activity commencing to the final stages of completion. Five quality standards were created by the ISO organisation in 1987, namely the ISO 9000 family: ISO 9000 and ISO 9004 that represent guidelines pertaining to quality systems being developed by the organisation; while ISO 9001, ISO 9002 and ISO 9003 comprise standards for conformance in terms of systems for quality assurance applicable to the client–supplier relationship, with the latter three known as contractual standards.

Besides the ISO 9000 standards regarding the systems of quality management, various ISO series were developed later such as environmental management through ISO 14000, and standards to manage occupational health and safety through OHSAS 18000 (Olivier, 2013). Although the approach of these standards is not the aim of this study, the current trend of implementing management systems to address the environment, quality, and health and safety at work can be stated, which became possible due to concerns for the harmonisation of standards associated with these domains. There are also a series of standards specific to some fields of activity such as food, construction, motor, and nuclear. In the motor industry, one relatively new standard is ISO/TS 16949, created by the International Automotive Task Force and subject to approval by ISO (Kartha, 2004). This is the first international standard in the automotive industry, recognised worldwide. ISO/TS 16949, alongside ISO 9001, stipulates the requirements for QMSs, which include design and development, and the set up and service of products related to vehicles, as well as production. ISO/TS 16949 certification is not possible without prior ISO 9001 certification; in fact, ISO/TS 16949 should be a guide for applying ISO 9001 in the motor industry. The development of effective quality systems in the food industry presumes, besides the application of ISO 9000 standards, implementing systems for Hazard Analysis and Critical Control Points (HACCP) through ISO 22000 (management of food safety) (Arvanitoyannis, 2009). HACCP is a quality system for food safety that ensures the prevention of microbiological, chemical and physical contamination of foods, which can affect the health or life of the consumer. The HACCP system entails systematically analysing the production and selling processes of food to determine the possible risks that may occur and to establish critical control points where action must be taken to prevent contamination. In addition, there are other standards for management systems with ISO 9001, and those which include additional requirements specific to the covered field: ISO 13485 (QMSs for medical devices), ISO 17025 (calibration and testing in laboratories), and ISO 45001 (health and safety) (Popescu et al., 2017); as well as ISO/IEC 90003 (software engineering), ISO/TS 17582 (QMSs specifying specific necessities for ISO 9001 to be applied by national electoral organisations), and ISO 18091 (QMSs for local government to apply ISO 9001) (Popescu et al., 2017; Raweni, 2018). Project management standards are addressed by ISO 21500, which was created by the ISO as a result of the collaboration between 30 nations and released in 2012 (Huda et al., 2018). ISO 21500 does specify the processes' techniques and tools, paving the way for specialists to apply those best suited for the project from a range of QMSs, which is beneficial in construction projects as it increases the possibility of adapting to the most suitable management system in the given circumstances, thus benefitting from the diverse range of innovative tools and techniques that are available on the global stage (Brioso, 2015). Figure 3.4 presents and summarises the functions of a range of ISO standards.

Introduced	Standard	Description
1987	ISO 9000	QMSs – fundamentals and vocabulary
1987	ISO 9001	QMSs – requirements
1987	ISO 9002	Implementing a QMS for product manufacture and delivery
1987	ISO 9003	QMSs – inspection and testing
1987	ISO 9004	Managing the sustained success of an organisation
2007	ISO 10001	Quality management – customer satisfaction – guidelines for codes of conduct
1995	ISO 10005	QMSs – guidelines for quality plans
1997	ISO 10006	QMSs – guidelines for quality management in projects
2013	ISO 10008	Quality management – customer satisfaction – guidelines for B2C e-commerce transactions
2003	ISO 10012	Measurement management systems – requirements for measurement processes & equipment
2001	ISO/TR 10013	Guidelines for QMS documentation
1999	ISO 10015	Quality management – guidelines for training
1999	ISO/TR 10017	Guidance on statistical techniques for ISO 9001:2000
2012	ISO 10018	Quality management – guidelines on people
1996	ISO 14000	A series of standards on voluntary environmental regulation
1999	ISO/TS 16949	A technical specification for QMSs in the vehicle industry
2012	ISO 21500	Guidance on project management standards
2013	ISO 45001	Managing occupational health and safety

Figure 3.4: A selection of ISO standards (modified from ISO, 2016a)

3.4.1 The ISO 9000 family of standards

As explained above, the ISO 9000 family was created in 1987 and was defined by Hoyle (2018) as a series of standards for QMSs that are applicable internationally and specify the recommendations and requirements for management systems in terms of their design and assessment. The family does not represent a product standard, nor do any of the standards include requirements that can be complied with by a product or service. Moreover, with ISO 9000 not featuring any criteria for product acceptance, products cannot be inspected against the standard.

Heize and Render (2009) indicated that there has been a broad acceptance of ISO 9000 internationally as an individual standard of quality, while others have defined it as a group of standards relating to QMSs and intended to help organisations satisfy their clients' and stakeholders' requirements (Poksinska et al., 2002). Those needs explicitly described in the product or service specification represent the stated needs, while those not explicitly asserted by the client represent the implied needs that can be found in the specifications for the product or service. A new range of ISO 9000 was produced in 1994: ISO 9000:1994 featured five standards (ISO 9000, ISO 9001, ISO 9002, ISO 9003, and ISO 9004) where the emphasis was placed on the assurance of quality through preventive measures as opposed to any final-product verification. Moreover, proof of compliance alongside procedures that were documented was still required. ISO 9000:2000 represented a revised form that included the ISO 9000 and ISO 9004 standards, while uniting ISO 9001, ISO 9002 and ISO 9003 within the single ISO 9001:2000 standard, whereas the family of standards known as ISO 9000:2000 was categorised into three standards: ISO 9000 (QMS with emphasis on the fundamentals and vocabulary), ISO 9001 (QMS with the focus placed on the requirements) and ISO 9004 (QMS including guidelines in terms of improvements to performance). This family of standards introduced new concepts such as (i) the QMS as opposed to quality assurance, (ii) the emphasis on client satisfaction through the QMS applied via the process approach (see Figure 3.5) (ISO, 2008), and (iii) ongoing improvement as an explicit necessity. This set of standards underscored the top management's commitment and role in the standards' implementation.

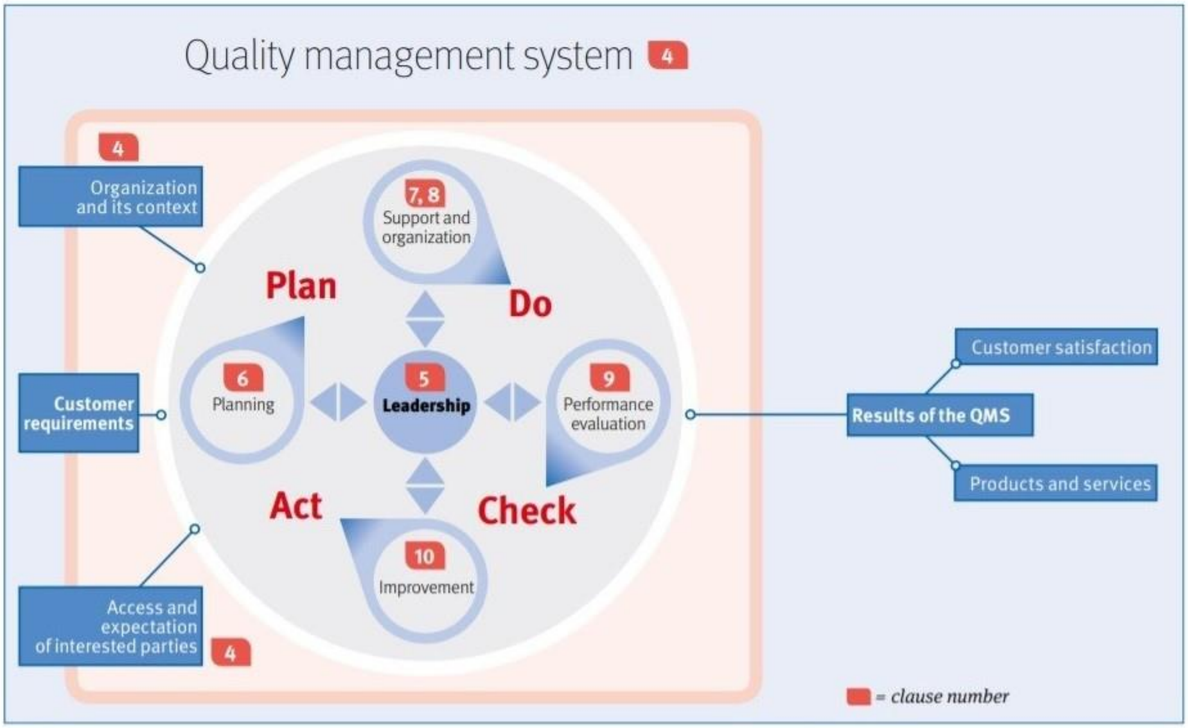

Figure 3.5: The ISO 9000 family embedded in the process approach (ISO, 2016a)

The PDCA methodology presented in Figure 3.5 is applicable to all processes (and adopts Shewhart's model presented in Figure 3.1), with the cycle representing the philosophy of all standards from the ISO QMS family. Organisational effectiveness can be managed and continually improved by following this cycle, no matter what the level of business. It can be described as follows: (i) plan by establishing the aims and developing plans, (ii) do by implementing these plans, (iii) check by measuring or monitoring the outcomes versus the established aims, and (iv) act by taking steps to correct and improve the plans to attain enhanced results (ISO, 2008). The cycle can be used for continuous improvement; when commencing a new project; when developing a new product, service or process; or when defining new work (Rumane, 2018). However, in their study investigating the cycle in terms of the delivery of timely, safe, effective, efficient and equitable healthcare, Reed and Card (2016) reported that the resources and support necessary to successfully apply it are often underestimated, with insufficient financial and human resources leading to failure, an undermining of the organisational culture, and 'change fatigue'. Therefore, they suggested that to ensure a successful outcome, considerable investment in expertise, leadership and resources is required.

The ISO 9000 series are standards for QMSs. The current edition of this series includes the next three standards: ISO 9000:2015 QMSs (fundamentals and vocabulary), ISO 9001:2015 QMSs (requirements), and ISO 9004:2009 (ensuring an organisation's ongoing success via a quality management approach). International standards of the ISO 9000 family have been adopted as European standards, with this adoption being signalled through the abbreviation ISO EN (e.g. ISO EN 9001). National standards' bodies are also in charge of the adoption of the international and European standards, with nation-specific abbreviations being used in this case (e.g. DIN in Germany, NF in France, ES in Spain, SR in Romania). Figure 3.6 presents the definition of the ISO 9000 series and evolution.

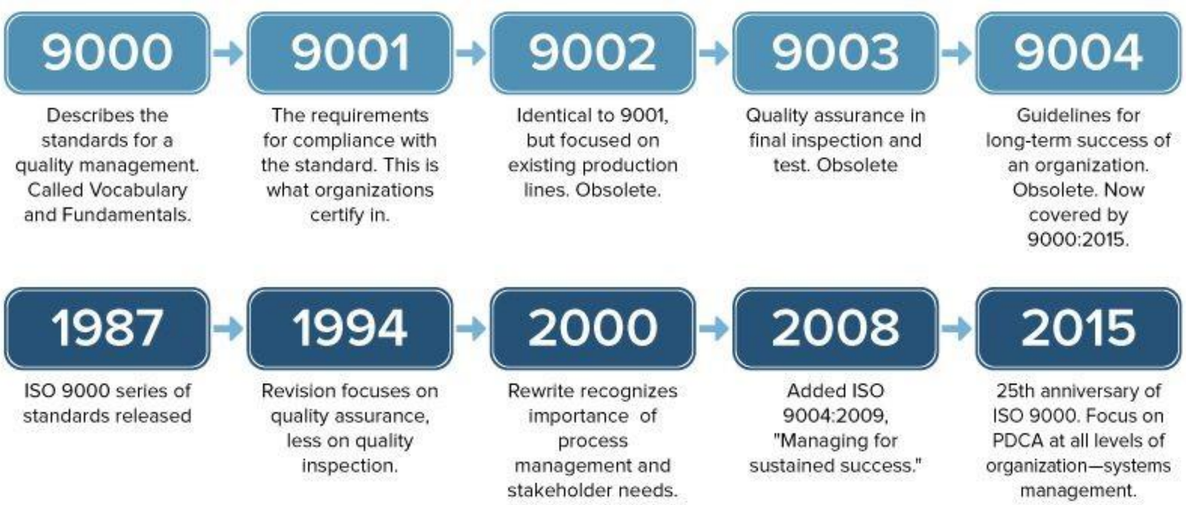

Figure 3.6: Defining the ISO 9000 series and evolution (Lokunarangodage, 2017)

3.4.2 The ISO 9001 standard

This study focuses on ISO 9001, a standard for management systems that is recognised internationally, with broad use worldwide. Although the application of ISO 9001 is not mandatory, there is a growing interest from organisations in its implementation (ISO, 2017). One of the reasons is that ISO 9001 certification often appears as a contractual requirement for companies that have a certificated QMS and impose it on their suppliers. There are also other internal and external reasons for implementing the ISO 9001 model, including client requirements, regulatory requirements, and enhancing the organisation's competitivity and image. ISO 9001 can be applicable to all organisations, regardless of the product provided or its size/ type. Currently, the ISO 9001 standard applies to all areas, within companies (e.g. industrial, tourism, and trade) and public-sector organisations (e.g. universities, administrative units, libraries, and hospitals).

The ISO 9001 QMS forms part of the ISO 9000 family, where the ISO 9001 QMS explains how organisations conduct business activities associated with quality. The ISO 9001 QMS is not a standard for products, nor does it define product quality. Rather, this is a management- and process-based standard that is utilised to control processes, which was developed to improve project performance and ensure project quality (Medić et al., 2016; Sickinger-Nagorni and Schwanke, 2016; Anttila and Jussila, 2017). Essentially, it comprises of the organisational structure as well as the documentation, processes and resources that are deployed to realise the quality objectives and fulfil the clients' requirements. There were no substantial changes from ISO 9001:2000 through to the issuance of ISO 9001:2008, although certain classifications were introduced in order to enable improved ISO 14001:2004 consistency. The requirements for ISO 9001 are grounded in particular principles of quality management, based on continuous improvement to achieve client satisfaction (Levett, 2005). There is a tendency for the ISO standards to place their lens of focus on delivering quality through the management of core processes that add value. The design of the ISO 9001 QMS standard is intended to support companies at a range of levels, which includes placing the emphasis on the client's requirements, enhancing leadership within the organisation, identifying opportunities for continuous improvement, and increasing performance (Medić et al., 2016; Sickinger-Nagorni and Schwanke, 2016; Anttila and Jussila, 2017).

Heras-Saizarbitoria et al. (2010) underscored that a significant number of adopters of the QMS highlighted a range of benefits including enhanced marketing, productivity and profits; increased employee motivation and morale; improved client satisfaction and retention; realising operations that are more effective and efficient; reduced waste and requirement for audits; and the promotion of international trade. The competition from an international perspective and elevated client awareness will mean that quality continues to be the determining client-satisfaction component and an essential facet of success in terms of achieving a competitive advantage. Since 1987 and its first appearance, the ISO 9001 standard has been broadly accepted, with the number of ISO 9001-certified organisations having grown exponentially, and a survey finding over one million certifications by the close of 2016 (ISO, 2017). Figure 3.7 presents ISO 9001's evolution.

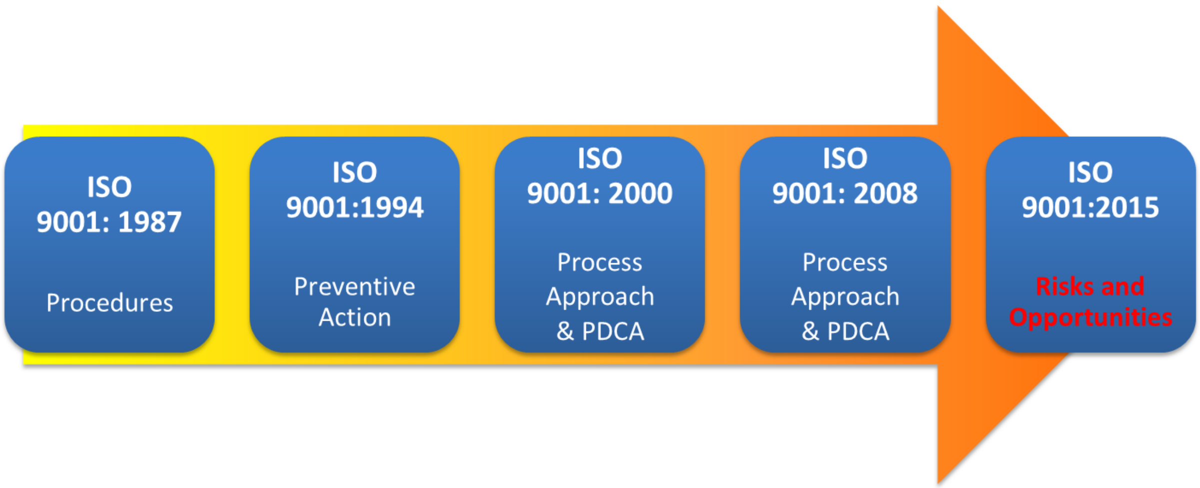

Figure 3.7: The evolution of ISO 9001 (Röyttä, 2016)

ISO 9001:2008 was the previous quality standard applicable in the market, which was further improved to form ISO 9001:2015. All the ISO 9001 versions were intended to evaluate the organisation's potential to design, create, and deliver services and products effectively while enhancing client satisfaction through the increased engagement of top-level management and ongoing improvement (Lokunarangodage, 2017). ISO 9001 employs an approach that is process based and intends to attain client satisfaction through fulfilling the client's requirements while continuously improving the system and avoiding nonconformity in products and/ or services. The standard offers organisational guidelines in order to create quality systems through placing the lens of focus on the control, documentation, and procedures, while indicating that particular features of a QMS can be standardised, offering benefits to clients and suppliers. On the other hand, the ISO 9001 standard is internationally recognised and designed to demonstrate its potential to transform the supplying organisation to ensure a fundamental degree of quality through the documentation and formalisation of its QMS, where its effective deployment is broadly perceived as facilitating the development of a competitive advantage in a sustainable manner, and thus increasing the performance of the organisation (Lokunarangodage, 2017).

The efficiencies of processes can be enhanced through ISO 9001 via general direction, documentation and continuous improvement to successfully attain client satisfaction and the quality objectives. In ISO 9001:2015, seven principles of quality management were developed: (i) focus on the client, (ii) leadership, (iii) ensuring participation, (iv) the process approach, (v) improvement, (vi) making decisions based on evidence, and (vii) managing relationships. These are explored as follows:

3.4.2.1 Client focus

Abuhav (2017) discussed internal and external clients, whereby the internal clients include those organisational members who are reliant on others within the organisation to fulfil their duties (e.g. the logistics department must provide the sales department (client) with a range of services such as the delivery of goods. External clients represent those that receive the final product or service (Abuhav, 2017). The focus on quality management in this study is primarily placed upon meeting the external client's requirements and striving to exceed their expectations wherever possible (ISO, 2015a, 2015c; Willar et al., 2015), with Luburić (2015) asserting the importance of understanding both current and future clients' requirements. Being client-focused means placing emphasis on satisfying the clients and understanding that profitability stems from this, with research necessary to establish and comprehend both the current and future clients' needs and expectations (Takim, 2009), which are ideally linked to the organisation's/ project's objectives (Sickinger-Nagorni and Schwanke, 2016). Moreover, organisations should place their focus on the intangible advantages to increased client satisfaction (Shaari et al., 2015). Top management should communicate the clients' expectations and needs organisation-wide, while the satisfaction of clients should be measured and the findings acted upon (Fonseca and Domingues, 2017a). Essentially, the organisation/ project should ensure an approach that is balanced between client satisfaction and that of the other stakeholders (Hoyle, 2018).

3.4.2.2 Leadership

The leaders at all tiers generate direction and purpose, while establishing an environment whereby individuals are focused on realising the quality objectives of the organisation/ project team through creating high-quality processes (Fonseca and Domingues, 2017a). It is the leadership's responsibility to create both a vision and a pathway for the project (Medić et al., 2013). Leadership implies realising exemplary behaviours that are compatible with and can deliver the organisation's values, while identifying challenging targets (Sickinger-Nagorni and Schwanke, 2016). Within the internal environment are the climate and culture, the management style, motivation, sharing, support, and trust (ISO, 2015a). Neyestani and Juanzon (2017b) asserted the importance of equipping and empowering staff members with the skills and resources necessary to conduct their role, with Chiocchio et al. (2011) reminding of the value of creating a trusting environment in which for them to operate. Berg and Karlsen (2016) explored the practice of 'coaching leadership', in which project managers reported four embodied skills: (i) the coaching of colleagues, (ii) the agility of leadership, (iii) feedback, and (iv) empowerment. The needs of all interested parties should be considered by the leadership including the clients, employees, financial backers, local communities, owners, the wider society, and suppliers (ISO, 2016a), with responsibility to the project partners ensured at all times (Sitnikov and Bocean, 2015). A clear organisational vision should be established by the leadership that sets challenging objectives (Röyttä, 2016), while ensuring commitment to both policy (Jabnoun and Sedrani, 2005) and the leadership role (Mansour et al., 2019). Moreover, the leadership should generate and maintain collective values, equality, and role models for ethics at all the organisational tiers, while embedding trust and eradicating fear (Sitnikov and Bocean, 2015). Furthermore, employees should receive the necessary resources, professional development, and space to proceed in an accountable and responsible manner, while the leadership should be inspirational and both encourage and recognise contributions from individuals within the organisation/ project environment (ISO, 2015c). The use of resources should be efficient (Jabnoun and Sedrani, 2005), with the project's environmental impact reduced insofar as is feasibly possible (Sadikoglu and Zehir, 2010).

3.4.2.3 Engagement of people

The organisation/ project team must ensure that all employees have the required competency and deliver value through empowerment and engagement, which enhances its value creation potential, with quality issues promoted through efficient teamwork (Willar et al., 2015). The motivation of employees must be maximised (Mansour et al., 2019), since when engaged, personnel are focused on the goals and values of their organisation/ project; they are driven towards contributing to the success of the organisation while simultaneously enhancing their well-being (ISO, 2016a). Moreover, they experience empowerment, role involvement, satisfaction, and commitment to the organisation (Sickinger-Nagorni and Schwanke, 2016). Ultimately, it is vital that employees feel that their abilities are both valued and utilised in order to enhance employee satisfaction, which is also important (Röyttä, 2016). Engaged personnel are competent, deliver value, and have enhanced perceptions in terms of the importance of their role (Fonseca and Domingues, 2017a), while they enjoy an elevated notion of the expectations of their job description. There are increased opportunities for progression, as well as dialogue and feedback with supervisors on a regular basis (Röyttä, 2016). Furthermore, an engaged employee's working relationships with his/ her colleagues, managers, and subordinates are considerably increased in terms of quality due to the more effective communication (ISO, 2015a, 2015b), whereby an open forum can develop for the discussion of issues (Fonseca and Domingues, 2017a) and barriers (Mansour et al., 2019).

3.4.2.4 Process approach

The results in the context of consistency and predictability can be more efficiently and effectively realised when tasks are comprehended and perceived as connected processes behaving as a system that is coherent (Wilson and Campbell, 2016); therefore, activities should be managed as processes, with a reduction in those activities identified as adding no value (Sickinger-Nagorni and Schwanke, 2016). The feasibility of activities should be determined (Aized, 2012), as well as the links that exist between them (Chiarini, 2017). That processes are dynamic is because they result in outcomes (Fonseca and Domingues, 2017a). All processes should be audited, and those processes identified as adding no value should be reduced (Mansour et al., 2019). Jabnoun and Sedrani (2005) reported the need to establish the knowledge required for the processes to operate, where this understanding then must be maintained (Sickinger-Nagorni and Schwanke, 2016). Action should be taken to address risk (Dumitrascu and Nedelcu, 2012), as well as to exploit opportunities that may present (Mansour et al., 2019). Organisational/ project processes should be structured to enable the achievement of particular objectives both effectively and efficiently (Sickinger-Nagorni and Schwanke, 2016). Such processes help in terms of (i) establishing the activities necessary for the achievement of the required results in a systematic manner; (ii) managing vital activities through setting concrete parameters for accountability and responsibility; (iii) the analysis and measurement of key activities' capabilities; (iv) identification of the links of these vital activities from within and between the organisational functions; and (v) evaluating the threats, effects, and outcomes of activities for the client, the other stakeholders and the suppliers (ISO, 2015a, 2015b). QMSs are developed through the linking of interconnected processes to enable the organisational objectives to be achieved, namely, the stakeholders' satisfaction (Sitnikov and Bocean, 2015). This facilitates in allowing a system to be structured to effectively and efficiently realise the organisation's objectives and to understand the interdependencies between the system's processes, while providing enhanced awareness of the responsibilities and roles required to enable the common objectives to be achieved, and thus minimise cross-functional obstacles while identifying and describing how certain system activities should proceed (ISO, 2016a).

3.4.2.5 Improvement

Successful organisations should identify the requirements necessary to promote improvement (Hoyle, 2018), continually focusing on improvement in terms of the organisational/ project's effectiveness and efficiency (Chiarini, 2017), while conducting operational planning (Mansour et al., 2019) as well as operational control (Chiarini, 2017). In terms of ensuring continuous improvement, resources should be both provided (Hoyle, 2018) and managed (Hola, 2015), with documentation made available to allow corrective action to take place (Anttila and Jussila, 2017). The organisation/ project team should (i) utilise a broad strategy to enhance its improvement mechanisms and tools, (ii) provide training in these, (iii) set an objective for every member of the personnel to allow the organisational processes and products to be improved. and (iv) establish guidance and leadership goals (ISO, 2015a, 2015b, 2016a). Mansour et al. (2019) underscored the importance of enabling the project team to participate in improvement, and Shaari et al. (2015) the need to consistently measure improvement. Performance should be analysed (Willar et al., 2015) and improvement celebrated (Anttila and Jussila, 2017), with a reward system developed and introduced to increase motivation (Chiarini, 2017).

3.4.2.6 Evidence-based decision-making

Ensuring access to exact and reliable data is vital (Fonseca and Domingues, 2017a), which must then be analysed through appropriate methods (Medić et al., 2016). Decisions grounded in the evaluation and analysis of data or information will have a greater likelihood of leading to the required outcomes, whereby the analysis of processes' data can be utilised to inform decisions (Anttila and Jussila, 2017). Information in the form of evidence demonstrates existence or truth and can be gathered by conducting measurements, observations, tests, and so forth (Anttila and Jussila, 2017). Arriving at decisions should be grounded in evidence, with the organisation assuring that the data or information are accurate and reliable to a sufficient degree (Fonseca and Domingues, 2017a). The organisation should ensure that the data are available as required, should analyse the data with appropriate instruments, and then form decisions and action them on the basis of this analysis, experience, and intuition (ISO, 2015a, 2015b). There is real importance in evaluating the effectiveness in terms of the actions adopted to deal with risks as well as to address opportunities (Fonseca and Domingues, 2017b). Willar et al. (2015) underscored the need to monitor performance, while other studies advised that performance should be both measured (Mansour et al., 2019) and analysed (Neyestani and Juanzon, 2017a). It is vital that individual performance is evaluated (Hoyle, 2018), while regular internal audits should be conducted (Hoyle, 2018). Finally, Medić et al. (2016) cautioned on the need to strike a balance between practical experience and the analysis of data.

3.4.2.7 Relationship management

In order to achieve success that is sustainable, organisations/ project teams should effectively establish (Moracanin, 2012) and manage their relationships with the stakeholders, that is, any group or individual concerned with the success or performance of the organisation/ project, including financers, clients, employees, owners, partners, suppliers, unions, or the general public (Manders et al., 2016). Stakeholders may be directly impacted by the organisation or focused on its performance and can be located within or external to the organisation/ project team (ISO, 2015a, 2015b). The relation management of stakeholders involves the dissemination of goals, knowledge, values, and understanding, while suppliers are not viewed as hostile entities (Sickinger-Nagorni and Schwanke, 2016). Therefore, it is vital to share plans (Hoyle, 2018), resources (Chiarini, 2017), and expertise (Anttila and Jussila, 2017) with the stakeholders. The organisation/ project team forms short- and long-term relationships (Mansour et al., 2019), where the longer-term goals are balanced by the shorter-term advantages, while know-how and resources are shared with partners (Röyttä, 2016). Cooperation in the development of activities is vital (Hola, 2015). The organisation/ project team identifies and selects its essential suppliers, ensuring that communication with the stakeholders is transparent. Information and plans for the future are shared, and the organisation/ project team conducts activities in the domain of combined development while motivating, encouraging, and recognising the achievements and improvements made by its suppliers (Fonseca and Domingues, 2017a). Figure 3.8 presents an overview of the seven QMPs of the ISO 9001:2015 QMS.

Figure 3.8: Overview of the ISO 9001:2015 QMS QMPs

3.5 ISO 9001:2008 vs ISO 9001:2015

Given that ISO 9001:2015 was adopted as the fifth edition of the standard, which replaced the 2008 edition, this section presents the relevant aspects of quality management with emphasis on the differences regarding the requirements and structure of QMS between the two editions.

According to Sitnikov and Bocean, (2015), if the ISO 9001:2000 and ISO 9001:2008 were said to be grounded in a process-based approach, the most recent 2015 edition of ISO 9001 is primarily based on meeting the identified requirements. Ensuring a process-based approach is achieved through the inclusion of additional requirements compared to previous versions. These include (i) establishing the anticipated actions and outcomes, (ii) identifying the threats and opportunities, (iii) determining those indicators of performance that are necessary to confirm that the processes are functioning effectively, (iv) allocating authority and responsibility, and (v) modifying processes to realise the required outcomes. ISO 9001 now features risk management as a vital component. ISO 9001:2015 recognises the importance not only of targeting core processes, but also extends to focusing on risk, while the management of risk must include the delivery of products and services. Deysher (2015) asserted that by default, ISO 9001 includes the notion of managing risk; consequently, the ISO 9001:2015 standard incorporates this notion more explicitly into the system of management, where the focus on risk is already a component of the latest version in terms of an approach that is based on processes. Despite this focus having the primary objective of preventing risk, it can also highlight and capitalise on opportunities. The ISO 9001:2015 standard's key differences comprise the emphasis placed on organisational context and risk-based management (ISO, 2015b), where the ISO 9001 QMS can realise planned results while preventing or reducing the negative impacts of risks that emerge, thus ensuring ongoing improvement (Sitnikov and Bocean, 2015). Hoyle (2018) reported that when considering ISO 9001:2015 and the earlier 9001:2008 standard, the key differences are that the more recent standard places increased emphasis on risk-based thinking and leadership engagement, while more effectively addressing the management of supply chains. Table 3.1 summarises the QMS structure provided by both editions of the standard and their corresponding clauses, where the clauses are the guidance of the ISO 9001 principles and requirements (Popescu et al., 2017). It can be seen that in the 2015 revision, further guidance has been included, such as establishing the QMS's scope and its processes (Context of the organisation); certain guidance has been modified, such as the focus on 'leadership' and commitment (Leadership); while some guidance has been removed (e.g. control of equipment for measuring/monitoring); and clauses have been refocused (e.g. Management responsibility > Leadership, Production realisation > Support).

Table 3.1: The QMS structure and clauses provided by the 2008 and 2015 standards (Popescu et al., 2017)

ISO 9001:2008	ISO 9001:2015
The scope	**The scope**
Normative reference	**Normative reference**
Terminology and definitions	**Terminology and definitions**
QMS	**Context of the organisation**
General requirements	Comprehending the organisation and its associated setting
Requirements for documentation	Comprehending the interested parties' expectations/needs
	Establishing the QMS's scope
	The QMS and its processes
Management responsibility	**Leadership**
Commitment	Leadership and commitment
Client-focused	Policy
Quality policy	Organisational authority, responsibilities and role
Planning	
Authority, communication and responsibility	
Review	
Resource management	**Planning**
Providing resources	Addressing risks/ opportunities
Human resources	Quality objectives and measures to realise them
Infrastructure	Change
Work environment	
Product realisation	**Support**
Planning to realise product	Resources
Client-related processes	Competence
Development and design	Awareness
Purchasing	Communication
Producing and providing a service	Documentation
Control of equipment for measurement/ monitoring	
Measurement, analysis and improvement	**Operation**
General	Operational control and planning
Monitoring and measurement	Products' and services' requirements

Non-conforming product control	Development and design of products/ services
Data analysis	Control of externally sourced processes/ products/ services
Improvement	Provision of products/ services
	Release of products/ services
	Non-conforming output control
	Performance evaluation
	Monitor, measure, analyse and evaluate
	Internal audit
	Management review
	Improvement
	General
	Non-conformity and corrective measures
	Continuous improvement

3.6 The benefits of using ISO 9001

According to Manders and de Vries (2012), applying the ISO 9001 QMS standard enhances performance, although those organisations intending to improve internal quality enjoy greater benefit than those employing the standard for external reasons such as clients, the market, or government pressure, where the extent that the principles of ISO 9001 are internally assumed relies on the organisational motivation (e.g. enhancing productivity and efficiency), and is believed to be vital to ensuring that implementation is successful. Externally motivated organisations have a tendency towards the implementation of measures determined by the standard as a solution for emergencies; those that are internally motivated have a greater likelihood of employing the standard and its fundamental principles in daily quality-improvement decisions, where the internalisation of the principles of ISO 9001 is deemed necessary in terms of ensuring that the most pertinent advantages from the QMS standard are achieved (Manders et al., 2016).

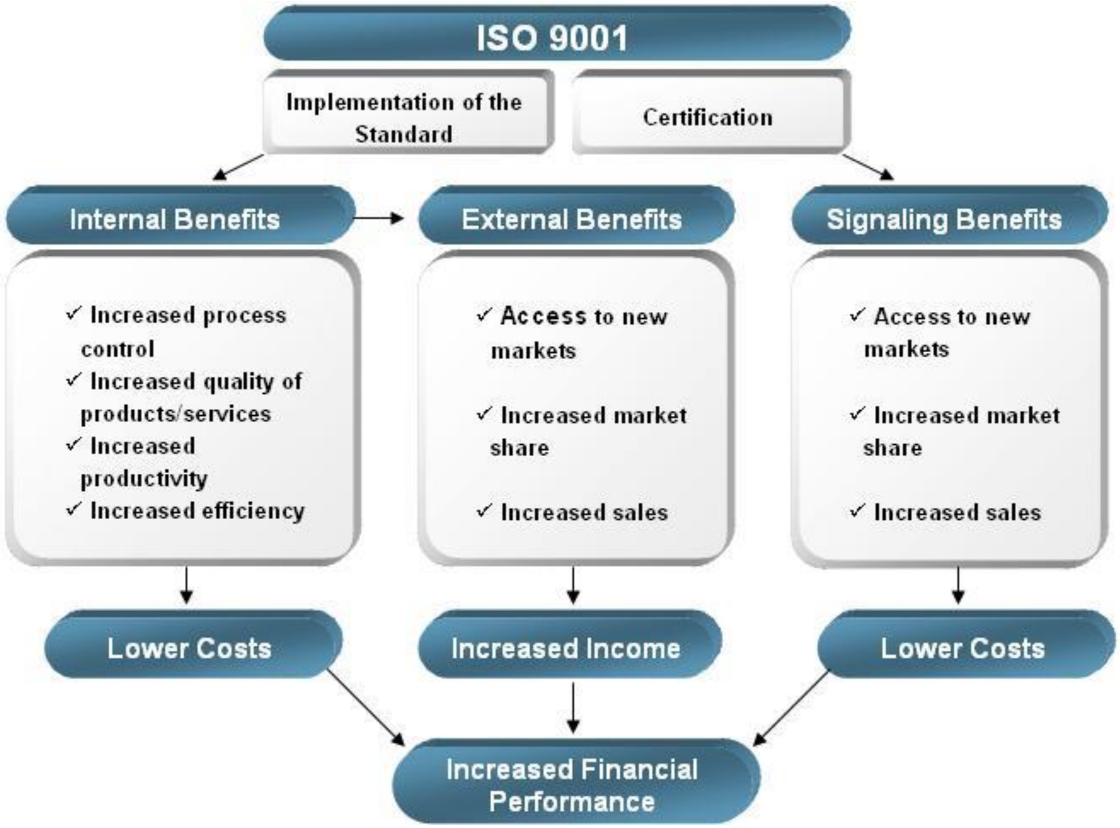

Figure 3.9: The benefits of using ISO 9001 (Manders and de Vries, 2012)

To clarify the impact of ISO 9001 on financial performance, Maunders and de Vries (2012) analysed the empirical findings from 42 studies through a meta-anlysis, to determine whether the financial perfomance improved after ISO 9001 certification, where they found that certification does improve financial performance, not only through greater sales (external benefits), but also via enhanced productivity and efficiency (internal benefits) and reduced costs (signalling benefits) (see Figure 3.9). Nevertheless, de Castillo-Peces et al. (2018) reminded that quality improvement is a long-term process, and therefore continual investment is necessary post-certification to ensure that a higher degree of benefits are realised from adhering to the standard. Nichols (2013) reported that ISO certification can also improve internal communication, processes, and the supplier and client relationships, while providing financial benefits for stakeholders. Therefore, becoming certified has the potential to offer a plan that allows quality to be defined and the strategic plan to be continually improved. Nichols (2013) offered a case study to demonstrate how the ISO 9000 requirements have the ability to resolve problems that were previously undefined, where a large vehicle parts manufacturer employed four stages to allow the production of parts within a 24-hour period. Nevertheless, the third stage incurred a 60% issue rate, with the problems resolved by the subsequent two shifts. Therefore, the issues were being resolved by paying additional wages, while the broader problem was never fixed. However, by introducing ISO 9000 and record keeping, analysing these and carrying out corrective actions, the 60% rework loop was immediately resolved. Moreover, while the young, relatively uneducated employees were unaware of quality management and ISO, the facets changed were vitally important to them.

Wu and Chen (2011) and Kafetzopoulos et al. (2013) found that ISO 9001 results in a positive impact on the success, development and innovation of organisations and their products. Aravind and Christmann (2011) indicated that almost all researchers focus on the effect of being ISO 9001 certified, as opposed to the impact of ISO 9001 implementation. Implementation in a homogeneous manner is assumed. However, being a certificate holder does not equate to implementing the ISO 9001 standard, since ISO 9001 certification might be obtained without the appropriate and regular adoption or utilisation of the standard. Therefore, the importance of this study is underscored by its emphasis on the influence of the ISO 9001's effective implementation on the organisational success and those barriers that limit the potential for implementation.

The project benefits achieved by ISO 9001-certified construction companies can be organised into internal benefits, including organisational gains that assist the staff and internal operations such as enhanced company communication, efficiency and productivity, employee morale, documentation, the quality of completed work, and working techniques, as well as reduced wastage of materials (Willar, 2012); the external benefits indicate those that can be perceived by the clients as enhancing the company's corporate image, increasing profitability, elevating sales with established clients, enhancing supplier relations, increasing the number of new local clients, reducing problems in terms of the defect liability period (Aized, 2012), more projects completed on time, and more agreements or contracts in the construction market, among others (Keng and Kamil, 2016).

From the previous discussions, the researcher has identified and summarised the most common internal and external advantages of implementing the ISO 9001 QMS standards to build up a theoretical base for this study, as depicted in Table 3.2 below.

Table 3.2: The most common internal and external benefits of implementing ISO 9001

Internal Benefits		References
i)	Strengthen internal communication between the project team	Nichols (2013)
ii)	Improve project documentation	Aized (2012)
iii)	Enhance project work techniques	Manders et al. (2016)
iv)	Improve the quality of work done	Manders and de Vries (2012)
v)	Raise staff morale	Chua et al. (1999)
vi)	Increase the efficiency of the project	Manders et al. (2016)
vii)	Increase the productivity of the project	Wu and Chen (2011)
viii)	Reduction of material waste in the project	Kafetzopoulos et al. (2013)
External Benefits		**References**
i)	Enhance the contractor's image in the construction market	Willar (2012) Manders et al. (2016)
ii)	Improve the contractor's relationship with project stockholders	Keng and Kamil (2016)
iii)	Projects completed on time	Manders et al. (2016)
iv)	Reduced project issues in terms of the liability period for defects	Aized (2012)
v)	More clients and contracts in the construction market	Manders et al. (2016)

3.6.1 ISO and procurement

In his report on contractual systems and procurement of the UK's construction industry, Latham (1994) highlighted that clients commission projects in order to achieve their broad objectives, whereby their desired project outcomes will include (i) good value, (ii) aesthetical appearance, (iii) absence of defects, (iv) completion on schedule, (v) fitness for purpose, (vi) the presence of guarantees, (vii) acceptable maintenance costs, and (viii) suitably durable. Procurement is a system that an organisation employs to effectively and efficiently manage the procurement process to promote the achievement of successful project outcomes while managing the risks involved in the construction industry and controlling for costs. The procurement system in the construction industry context can be beneficial in terms of (i) assisting in the preparation of tender documentation and contracts, (ii) selecting contractors and consultants, (iii) providing a template for effectively maintaining the contract, (iv) enabling regular monitoring and reporting, and (v) assisting in the resolution of disputes (Patil and Nadaf, 2017). In terms of ISO and procurement, government-funded projects are generally required to engage with a competitive tendering process, where the lowest tender typically wins the contract (even though this may not necessarily be the best option), while privately funded projects have greater flexibility when evaluating the tender documents, and can either also choose the lowest bidder, or they may select a contractor and then negotiate the terms of the contract (Rumane, 2013). Regardless, as a result of the competitive and dynamic environment, where price is increasingly placed under pressure, quality becomes a vital component in the competitive process (Cârstea et al., 2014). In their research on construction exploring the analysis of risk and the strategic evaluation of procurement, Pawar et al. (2017) reported that the procurement process is a fundamental stage that breathes life into the construction project, and therefore the procurement approach will have implications for the entire lifespan of the project. They found the major reasons for threats and delays in the procurement context to be the availability of funds, the contractor's and the suppliers' technical ability, the suppliers' financial stability, and the contractor's involvement in the procurement process.

Proverbs et al. (2000) described the procurement process in construction projects as typically following a traditional route, whereby the client engages with three different organisations to address (i) the design, (ii) the cost and measurement, and (iii) the construction. In terms of the impact on quality, they reported that this traditional approach leads to problems due to (i) the nominated sub-contractors having greater loyalty to the architect (who nominated them) than the contractor or client; (ii) the separation of the design and the construction stages, leading to divisions that erode 'team sprit', an essential component for success; (iii) the design and construction phases can be lengthy, and unsatisfactory communication can arise between the client and contractor, since the process is sequential; and (iv) responding to change can be a primary cause for increased delays and costs (Proverbs et al., 2000). Therefore, procurement is a vital stage in terms of ensuring that quality outcomes can be ensured. In their study exploring quality management in pharmaceutical procurement, for example, where they audited seven Bulgarian pharmaceutical wholesalers against the requirements of ISO 9001 (2000 and 2008), Stoimenova et al. (2013) reported an increase in

ISO 9001 certification amongst the wholesalers since 2004, when certification was made mandatory to be eligible for Bulgarian hospital tenders.

Dellana and Kros (2018) explored ISO 9001 certification and the quality of the supply chain in the US context through an email questionnaire completed by 565 supply chain professionals, where they reported that companies have a higher likelihood of adopting ISO 9001 as part of their broader quality management strategy, rather than the belief that certification is essential to respond to pressure from the market. Moreover, they revealed that those organisations who are ISO 9001 certified have an increased likelihood of having mature quality programmes, and are more likely to utilise ISO 9001-compliant suppliers. However, in another US study investigating ISO 9001's impact on product quality, Blessner et al. (2013) found that in the defence procurement context ISO 9001 certification may not guarantee that the product quality is superior to that produced by non-ISO 9001 certified organisations, and might also result in higher product costs to compensate for achieving and maintaining such certification.

ISO (2016b) underscored that ISO 9001 does not provide concrete specifications for the purchased products or services, but rather the accredited company must specify its requirements to the supplier. The organisation stipulated that for a supplier to confirm that its QMS satisfies ISO 9001's requirements, this can be achieved through the supplier providing a declaration of conformity, a second party assessment (e.g. where a trusted client affirms its conformity), or a third-party assessment (e.g. through certification or registration) (ISO, 2016b). Suppliers cannot claim that their products or services meet ISO 9001, but rather that they have implemented a QMS that meets the standard's requirements, and therefore that they have "the ability to provide consistent, conforming products or services" (ISO, 2016b, p.11). Essentially, the long-term viability of organisations can be achieved through producing quality products competitively, where designing and implementing processes for the management and procurement of material resources offers significant opportunities for enhancing quality (Cârstea et al., 2014).

3.7 The importance of the ISO 9001 QMS in construction projects

The ISO 9001 QMS is a more modern approach that requires the QMS to be appropriate to its strategic goal and objectives, while also assuring that its requirements are incorporated into the processes of the organisation, so the QMS must be assimilated into the wider business (PricewaterhouseCoopers, 2016). The ISO 9001 QMS standard's objectives include supporting companies through placing the lens of focus on the client's requirements, enhancing organisational leadership, identifying opportunities for continuous improvement and increasing the levels of performance (Medić et al., 2016; Sickinger-Nagorni and Schwanke, 2016; Anttila and Jussila, 2017). Ultimately, the standard facilitates in addressing the management and processes of construction projects to positively impact the quality outcomes. According to Gatz (2015), the ISO 9001 QMS allows for greater flexibility and creativity in terms of the documentation. There are no longer specific requirements for documented procedures and records, or for a quality manual. Therefore, the organisation must be fully aware of what needs to be included in the documentation, which records must be retained, and what formats of documentation are suitable in order to ensure conformity and be ready for continuous development. If the organisation is currently certified in accordance with ISO 9001, it will need to adopt the latest ISO every time one is released. The questions that the external audits will submit each time will directly relate to the new and changing requirements to be developed to comply with the update, until the ISO certificate is renewed, which allows entry into the market (Biswas, 2017). Biswas (2017) explained that the organisation should conduct regular internal audits to generate data on the QMS's potential to fulfil the requirements of the organisation and the ISO 9001:2015 standard, and that it is being maintained and implemented effectively. The organisation must report the audit results and take necessary actions that are corrective and timely, while retaining evidence of the audit programme's implementation and results. Consequently, the ISO is a renewable system that keeps pace with the development of the environment around the organisation. The concept and philosophy of the latest ISO version has become a measure based on risk management, whether negative (threats) or positive (opportunities), while risk-based thinking implies that ISO standards are no longer merely preventive action, as per the philosophy of other quality systems, but that they evolve (PricewaterhouseCoopers, 2016). The Project Management Institute (2013) identified risk as an event or situation that is uncertain and can lead to a favourable or negative impact on the project's objective(s), such as the cost, quality, scale, and schedule, and whether an event may affect more than one element. Organisational personnel may be the cause of a particular requirement, presumption, restriction, or state that generates the potential for certain negative or favourable results. The new emphasis is placed on risk-based thinking, which encourages examining the organisational context and choosing a risk mitigation technique that is most appropriate. Risk-based thinking through a systematic approach can allow significant savings in terms of time management and must be entrenched in the organisation as a process of ongoing evolution to refine the development of knowledge and reactivity (Gatz, 2015). A mentioned above, rather than being a standard for products or defining product quality, the ISO 9001 QMS is a process-based standard that is employed to control processes and ensure that the final outcome satisfies the desired requirements (Medić et al., 2016; Sickinger-Nagorni and Schwanke, 2016; Anttila and Jussila, 2017).

It can thus be seen that ISO 9001 represents a modern system that supports projects to achieve success and their goals within the parameters of cost and quality, and thus ISO 9001 is closely investigated in this study through the medium of construction projects. The ISO 9000 quality standard is vital for organisations that aspire to become leaders on the international stage. Moreover, ISO 9001 is significantly more preferable to other QMSs as it includes quality management guidelines and can operate independently. According to Bishop (2016), it is possible for an organisation to transition from no quality system to achieving ISO certification in six months, while TQM programmes typically require at least one year to implement.

As asserted by Neyestani and Juanzon (2016), the majority of construction projects encounter a range of challenges in terms of completing their projects that include 'manufacturing defects', delays, and cost overruns, while globalisation and rivalry have expanded worldwide during the past three decades, representing critical facets that every construction project must address in order to accomplish its aims via management tools. Successful project management was defined by Kerzner and Kerzner (2017) as the project's objectives being achieved within the cost parameters, on time, and to a standard that meets the client's quality requirements. The most significant factor that determines the successful outcome of construction projects is quality, but various reports have criticised the construction industry, particularly as far as efficiency and quality are concerned (Ali and Rahmat, 2010), while the overwhelming majority of the tasks that directors fulfil centre around cost and time, as opposed to client satisfaction and functionality.

Mane and Patil (2015) asserted that greater consideration should be placed on quality, while according to Rumane (2016), poor quality leads to the production of substandard products and services, with insufficient quality in construction projects due to substandard or unsustainable workmanship, unsafe structures, delays, overruns of cost, and disputes. In terms of public- and private-sector clients, both value and quality are of concern. Currently, quality does not merely apply to an organisation's products and services, but can also be associated with the processes. It was reported by Alberto (2011) that quality is a general philosophy in terms of construction projects, whereby the process is conducted through infrastructure that represents comprehensive quality. The overall infrastructure in terms of quality comprises of several main components, the most important of which is the quality system (Godfrey, 1999) as an instrument for business management.

Essentially, ISO 9001 is not merely a philosophy but a clearly defined system and an optimum tool for managing quality. Its core requirements are applicable globally, while external audits help to retain its preferred direction (Bishop, 2016).

3.8 The challenges hindering effective implementation of the ISO 9001 QMS in construction projects

The construction industry's unique nature, which tends to hamper the effective implementation of QMSs in this sector, leads to challenges in terms of introducing a QMS. In contrast to the manufacturing industry's fixed processes, the construction industry's processes tend to be bespoke (Bawane, 2017). According to Hadavi and Krizek (1994), the construction industry is unique due to (i) labour being mobile; (ii) construction projects' diverse forms, shapes, and types; (iii) the broad geographical distribution; (iv) the contractual relationships; (v) vulnerability to climatic conditions; and (vi) virtually every project being unique. There are a range of challenges to the effective implementation of QMSs in construction projects, including the bespoke nature of projects, lengthy project timelines, the challenges of ongoing relations between the parties, the problems associated with defining quality, and feedback on the construction processes, all of which restrict drives towards the improvement of quality (Leonard, 2010).

In addressing why the construction industry's effective implementation of quality management is so challenging in projects, Strange and Vaughan (1993) cited that the industry perspective construction leaders hold is what can be referred to as the five *can'ts*: (i) industrial management solutions cannot be applied to construction as a result of the industry's unique characteristics; (ii) statistical analysis of construction processes cannot be carried out because they are unique and therefore non-repetitive; (iii) investing in training at the role level is not possible as individual employment tends to be short term, there is a lack of project loyalty from individuals, and a challenging environment; (iv) funding management programmes is not realistic because of excessive competition and tight profit margins; and (v) heavy workloads leave limited time available to attend training seminars.

Landin (2000) underscored the challenges of construction projects implementing ISO 9001 in their projects resulting from the generic form of its clauses, whereas construction projects, contracts, practices and specifications are viewed as being project-specific, typically involving particular product or service outcomes, where any attempts to fully incorporate these within the generic system of ISO 9001 prove challenging. In cases where the objective of certifying with ISO 9001 is solely as a marketing strategy or due to pressure from the client, then there is no certainty of any improvement in project effectiveness resulting from the implementation (George, 2015). A major challenge to ensuring broader quality management acceptance and effective implementation in the construction industry cited by Harrington et al. (2012) is conventional practice, such as the traditional approach to bidding on projects where price is given the greatest emphasis. It is broadly accepted that the contractor is usually selected based on the most competitive price, with the client placing less importance on current workload, experience, and reputational quality; therefore, contractors have little incentive for the adoption of quality management.

The nature of successfully implementing quality management in the long term also leads to challenges, especially in the construction industry context; for example, sudden changes in the market may threaten the contractor's viability, thus redirecting the firm's attention from achieving its objectives in the longer term to implementing corrective actions in an urgent manner. Fluctuations in the construction industry are common, leading companies towards being reactive as opposed to applying a proactive approach. Adetunji et al. (2003) characterised the construction industry's fragmentation as being a primary factor affecting its performance and productivity. Construction projects typically entail numerous stakeholders that include the client, architect, contractors, sub-contractors, engineers, and suppliers in realising a unique project where considerable coordination is required (Isikdag and Underwood, 2010).

According to Boiral (2011), many project managers hold the belief that a QMS is merely beneficial in terms of employing the certification as a marketing mechanism. Consequently, managers frequently place their focus on the certification itself as the key objective, as opposed to the value of the projects, where this approach can cause process inefficiencies due to the lack of any effective QMS. Consequently, the majority of project managers do not tend to construct an adequate overview of quality in relation to the QMS, nor do they measure the short- and long-term potential for the project to add client value. Khattak and Arshad (2015) demonstrated that the most significant challenge in terms of the implementation of QMSs in construction projects is poor senior management support, while Rybski et al. (2017) cautioned that the paucity of evidence on QMS's actual impact on project performance and practices, such as inadequate QMS awareness and training, is a major challenge for construction project owners and project managers regarding effective QMS implementation. The construction industry is often characterised by a lack of standards, poor productivity, and unsatisfactory quality compared with the manufacturing industry (Aziz and Hafez, 2013). Before any parallels can be drawn between the two sectors, the respective operational environments should be considered, whereby the nature of the manufacturing industry is one that operates under a closely monitored environment, where those variables that impact on product quality can be controlled. Conversely, the construction in industry is characterised by unique outcomes where standardised processes may need to be modified to complete each project.

While there are a range of advantages offered by ISO 9001, a company being awarded certification does not necessarily ensure that all the possible beneficial outcomes will be realised, with George (2015) reporting weak understanding and training of the benefits of the ISO 9001 QMS, and Magd (2008) cautioning of the implementation challenges that manifest when the project team fails in terms of understanding and applying the QMS. Consequently, the majority of construction companies hesitate to implement the system since they are unsure whether the implementation is worthwhile (Keng and Kamil, 2016), with investment in training for specific roles being restricted by the short-term nature of individual employment (Al-Najjar and Jawad, 2011), while individual workloads leave a paucity of available time to participate in training seminars (Strange and Vaughan, 1993). Some construction companies believe that ISO 9001 implementation merely represents wasted time and finance for the consultancy, training, periodical audits, and a cost for the certification fee, while lacking any real benefits other than covering the requirements of the clients and competitiveness in the market (Neyestani and Juanzon, 2017b). Moreover, it must be noted that not all projects that implement quality improvement processes are successful, with many challenges to the successful implementation of quality in the long term (Adetunji et al., 2003), such as the inadequate knowledge of quality programmes (Khattak and Arshad, 2015), as well as project managers being resistant to the implementation of the ISO standards in their construction projects due to the perception that the standards will have a negative effect on practices (Leonard, 2010).

Loushine et al. (2006) asserted that construction is not automated but a dynamic process that is carried out on-site, where in contrast to engineered products that involve machines and technology, it is people that shape the construction project's outcome. Since it is a process that is highly complex, involving a range of interests and parties that extend from the architect, consultants, and owner, to the contractors and suppliers, by its very nature the construction domain would appear to be a significant obstacle to successful quality management. Love et al. (1998) found that construction industry performance is hampered due to its fragmentation, poor communication and coordination between parties, contractual relationships that are often adversarial, and the absence of client focus. Despite QMSs requiring development based on the project's particular environment and characteristics, Thomas et al. (2002) reported that in the traditional sense, QMSs generally fail to represent the workforce and place too great a focus on the control mechanisms, rather than the outputs deemed important by the client. Many construction project managers believe that the generic approaches to quality management based on ISO are rather bureaucratic, with the methods typically abstract in nature, and showing greater concern for the system of management than controlling the work processes. According to Pratt (1995), the ISO 9000 series has its equivalent in the British Standard BS5750 in quality systems and EN29000 in European Standards, whereby these standards establish formalised procedures and documentation is required, but quality assurance, by definition, does not result. This has led to organisations experiencing a substantial administrative and bureaucratic load, while the real advantage of such certification as a mechanism of ensuring quality is questionable. According to Anttila and Jussila (2017), ISO 9001:2015 is generally ambiguous and includes a number of incomplete and imperfect texts and requirements.

The design component of the ISO 9001:2015 QMS encourages greater planning of construction projects from a strategic perspective, where control of the external services component can be utilised to manage construction project contractors' performance whilst ensuring that their chain of supply satisfies the objectives of quality and the requirements in terms of price. In this context, selecting and managing the supply chain through the development of criteria and processes can offer construction projects significant financial, quality, and time benefits, while leadership of an enhanced nature in ISO 9001:2015 provides guidance for the construction project's aims, ensuring the realisation of targets in terms of both cost and completion time, whilst leading to improved quality (Nolan, 2016).

The main barriers to the effective implementation of ISO 9001 in construction projects include the lack of senior management commitment, staff resistance and the difficulties of conducting internal audits, the lack of advisory boards, the requirements of ISO 9001 appearing unachievable, and limited human and financial resources (Al-Najjar and Jawad, 2011). Magd (2008) highlighted the paucity of involvement by senior management, poor awareness of the ISO 9001's requirements for quality systems in corporations, insufficient staff training, and inadequate knowledge about quality programmes as representing the main barriers. Subrahmanya Bhat and Rajashekhar (2009) identified a range of challenges facing construction projects in attempting effective implementation of the ISO 9001 standard including limited financial and human resources, poor technical awareness in terms of quality management, and a weak understanding of formal systems, with Willar et al. (2015) and Chiarini (2017) reporting that training and education programmes should be regularly implemented to enable employees to manage increasingly complex issues. In addition, commitment from senior management is identified as a critical success factor directly affecting ISO 9000's successful implementation within any project. The root causes of underperformance may be factors influencing effective implementation and others such as excessive paperwork and misconceptions about ISO that reveal job security concerns. Poor experience in the performance of internal audits is due to limited understanding in terms of the QMS, the staff level of education, limited training, and low staff morale. Consequently, these critical success factors should also be considered. The management of quality results in real benefits including the reduction of costs that are non-quality as well as those activities and processes adding no value, along with intangible advantages including increased client satisfaction, the enhanced motivation of personnel, and a reduction in the environmental impact (Durai Anand Kumar, 2011). ISO 9001 certification is sought by project management for additional motives including the performance of the business, efficiency and maximising competitivity, pressure from the client, prestige, and the corporate image (McCrosson et al., 2013). Some construction project managers have expressed concern and resistance to the ISO standards being implemented in their projects, owing to the belief that the standards will have a somewhat negative effect on the practices at the management level, limit the available choices, offer uncertain commercial advantages, and increase bureaucracy (Boiral, 2003).

Historically, there has been a reluctance by the construction industry to address change, which has hampered ISO 9001's effective implementation in construction projects (Haupt and Whiteman, 2004). Quazi et al. (2002) questioned whether evidence can be presented about those construction projects that have already obtained ISO 9001 certification and whether they really provide high-quality products and services. George (2015) found that the ISO 9001 standard is typically mistaken as merely a documentation task to be completed by the project's management, as opposed to a set of instruments that can change and significantly improve management systems. Consequently, representatives responsible for quality management are restricting the preparation of quality documents and establishing a viable QMS, and are weak in terms of the authority to effect practical decisions or to implement change. Therefore, management often opt for the most flexible certification body as recommended by the consultant, underscoring a misunderstanding of the rationale for seeking certification through ISO 9001. Furthermore, as each construction project is unique, as well as its processes (Loushine et al., 2006), it is a challenge to implement a single system as a comprehensive solution for all projects (Anttila and Jussila, 2017), as seen in more standardised contexts where solutions can be developed and then repeatedly applied during the project's lifetime (Gibb and Isack, 2001; Perumal and Bakar, 2011; Ramaji and Memari, 2015).

From the previous discussions, the researcher has identified and generated the most common challenges hindering effective QMS ISO 9001 implementation in construction projects in order to build up a theoretical base for this study, as presented in Table 3.3 below. These challenges comprise the themes of managing change, to prevent a negative impact on the project's ability to complete on time, on budget and to the required degree of quality; client focus, to ensure that their needs and expectations are fulfilled; leadership, to boost staff morale and commitment; reducing the impact of non-standardisation on quality, performance and productivity; addressing the skills and training of personnel in terms of the quality standards and the advantages of QMSs; and managing relationships to avoid discord between parties and to promote collaboration over confrontation. With such issues identified, there is a clear need for remedies to reduce or overcome these challenges. In their paper exploring the barriers to ISO 9001 implementation in China, Zeng and Tian (2007) identified organisational issues in terms of over-expectation and the belief that the task was complete once certification was achieved, as well as oversight issues in terms of the commitment of and competition between certifying bodies. To overcome these challenges, they suggested increased government supervision of the audit process. In their study exploring the barriers to implementing TQM, Catalin et al. (2014) found that change in terms of the organisational culture is required to ensure that the client's expectations are met, along with increased involvement of the personnel. Then, in their investigation of the limited effectiveness of QMS implementation in architectural design companies in Iran, Abdirad and Nazari (2015) reported that the nature of their practice meant that some aspects of the QMSs were incompatible, and thus needed to be modified to more effectively address the organisational culture, the definition of design quality, the importance of the client, and how learning from the design process is achieved in their context. This study thus seeks to identify solutions to the issues highlighted in Table 3.3 through determining critical success factors for successful ISO 9001 implementation, as discussed in section 3.9 below.

Table 3.3: The most common barriers hindering effective ISO 9001 QMS implementation

Factor	Factor component	References
Change management	Quality is jeopardised when a project's plan is changed during construction	Leonard (2010)
	Throughout the construction process, frequent changes to the design details may be necessary, which threatens the quality process	Adetunji et al. (2003)
	Sudden changes in the market may threaten the contractor's viability	Strange and Vaughan (1993)
	Sudden changes in the market may redirect the project management's attention from achieving its objectives in the longer term to implementing corrective actions in an urgent manner	Harrington et al. (2012)
	Sudden changes in the market may lead project management towards being reactive as opposed to applying a proactive approach	Harrington et al. (2012)
	Fluctuations in the construction industry are common	Leonard (2010)
	Vulnerability to climatic conditions	Hadavi and Krizek (1994)
	Variables that impact on product quality cannot be controlled	Hadavi and Krizek (1994)
	Frequent feedback on the construction processes from the client and architect, and change in plans and designs	Adetunji et al. (2003)
Client focus	The client selects the contractor typically based on the most competitive price	Harrington et al. (2012)
	Client places less importance on the current workload, experience and reputational quality	Thomas et al. (2002)
Leadership	Lack of project management loyalty from staff, and the challenging environment	Hadavi and Krizek (1994)
	Construction projects involve a broad range of stakeholders in realising a project, where considerable coordination is required	Leonard (2010)

	Staff resistance and the challenges of carrying out internal audits	Jin et al. (2013)
	Lack of advisory boards	Pratt (1995)
	Lack of management commitment	Boiral (2011)
	Low staff morale	Pratt (1995)
	Limited funding management programmes because of competition and tight profit margins	Boiral (2003)
	Lack of human and financial resources	Bhat and Rajashekhar (2009)
Non-standardisation	The construction industry is characterised by its non-standardisation	Strange and Vaughan (1993)
	Construction projects' diverse forms, shapes, and types	Bawane (2017)
	Projects are invariably unique, as are the processes	Loushine et al. (2006)
	Broad geographical distribution	Hadavi and Krizek (1994)
	Difficulty in determining quality standards and reactions related to construction processes	Anttila and Jussila (2017)
	Construction fragmentation as a primary factor affecting its performance and productivity	Rybski et al. (2017)
	Construction projects are often characterised by a lack of standards	Bawane (2017)
	Statistical analysis of construction processes cannot be carried out because they are unique and non-repetitive	Haupt and Whiteman (2004)
	The nature of construction projects is operating without a closely monitored environment	Landin (2000)

Skills and training	Staff level of education	White and Marasini (2014)
	Insufficient staff training	Strange and Vaughan (1993)
	Poor technical awareness in terms of quality management	Rybski et al. (2017)
	Inadequate knowledge about quality programmes	Khattak and Arshad (2015)
	Difficulty in determining quality standards	Landin (2000)
	Investing in training at the role level is not possible due to the short-term nature of individual employment	Al-Najjar and Jawad (2011)
	Heavy workloads leaving limited time available to attend training seminars	Strange and Vaughan (1993)
	Inadequate awareness and training of the ISO 9001 QMS's benefits	George (2015)
	Quality implementation challenges arise due to the inability of the project team to apply and understand the standardisation or specification of the ISO 9001 QMS	Magd (2008)
	Poor experience in the performance of internal audits due to limited understanding in terms of the QMS	Al-Najjar and Jawad (2011)
	Poor awareness of the requirements of ISO 9001 for quality systems in corporations	Harrington et al. (2012)
	The nature of successfully implementing the ISO 9001 QMS in the long term leads to challenges, particularly in the context of construction projects	Adetunji et al. (2003)
	Managers' concern and resistance to the ISO standards being implemented in their construction projects, owing to the belief that the standards will have a negative impact on practices	Leonard (2010)
Relationship management	Contractual relationships	Pratt (1995)
	Poor communication and coordination between parties	Arditi and Gunaydin (1998)

	Human relations generally exist only once	Arditi and Gunaydin (1998)
	Construction is a process that is highly complex, involving numerous partners and interests	Love et al. (1998)
	Confrontation rather than cooperation characterises the stakeholders in construction projects	Harrington et al. (2012)
	Nominated sub-contractors generally have greater loyalty to the architect who selected them, which affects the team spirit	Adetunji et al. (2003)
	Separation between designers and contractors in construction projects compromises the team spirit, which is vital for the project's success	Adetunji et al. (2003)
	The numerous parties in the project that strive to safeguard their own interests during the lifespan of the construction process	Pratt (1995)

3.9 Critical success factors to support effective implementation of the ISO 9001 QMS in construction projects

Research has more recently turned to the investigation of those factors that can support successful project completion, and in particular those that can have a greater impact on successful outcomes, whereby critical success factors illuminate those organisational areas that can help to promote competitive performance (Ohol et al., 2019). Studies exploring critical success factors began in 1967, developing theoretical and empirical evidence to extend the field (Ohol et al., 2019). Rubin and Seeling (1976) first presented the notion of success factors related to projects, while the notion of critical success factors in project management was developed by Bullen and Rockart (1981), which they described as those few key areas where positive results are essential for managers to achieve their objectives. Neyestani and Juanzon (2016) reminded that with the objective of achieving a successful project outcome, it is essential to establish which factors will result in a project's success or failure. Howell (2010) stated that while the potential of critical success factors is substantial, they must be implemented well to be effective, and to be truly effective there is a need to include them within a management system, the programme goals, or planning process. Once these critical success factors have been identified, the next step is to aim for optimum performance on these factors, assess the progress, and take action where necessary.

In the TQM context, it is typical for the critical success factors to be initially established to ensure that the respective individuals or groups are focused on the collective mission (Mukherjee, 2019); however, while many critical success factors have been identified, it remains unclear what variables should be measured on the production line to determine the levels that such factors have achieved (Díaz-Reza et al., 2019). In the process quality management domain, a maximum of eight critical success factors should be established to realise the organisational vision and objective, which are then utilised to choose and prioritise the essential business processes (Riley, 1999). In their project quality management research involving a questionnaire survey and interviews that explored critical success factors for construction in Singapore, Low and Ong (2014) found that despite the critical success factors of the national Construction Quality Assessment System (CONQUAS) being accepted as key principles of quality, they were not being adhered to. For example, there was a misconception that implementation of the CONQUAS system would lead to increased final costs for the project and delays to the completion, while pressure from the clients to complete often led to quality management being undermined, as well as the impact of the limited communication, project planning ability and quality management competencies of the site personnel (Low and Ong, 2014). The authors recommended that the regulatory authority, the Building and Construction Authority, introduce legislation to compel construction companies to embrace the model. Their study identified five critical success factors and 33 factor components, with the five factors focused on the management of human resources, sub-contractors, the schedule, the materials, and the construction process (Low and Ong, 2014). The authors believed that by addressing these factors prior to any construction work taking place, the process outputs would be a very high standard of workmanship, as well as achieving high scores on their CONQUAS assessment system. To realise its full benefits, Abdullah et al. (2010) also found that enhanced enforcement of the CONQUAS system was necessary to ensure its comprehensive implementation from the initial stages until the project's completion. Tsiga et al. (2016) conducted a study to explore the critical success factors for success project outcomes through a questionnaire survey completed by 49 project managers based in various international settings, identifying 11 critical success factors and 58 factor components deemed to be vital to project success. They underscored the importance of further research in the construction project context to enhance the project delivery outcomes. Alias et al. (2014) investigated the strength of the relationship between project performance and critical success factors through a questionnaire survey of architects, engineers, construction staff, and project managers with experience in the Malaysian construction industry, where they found five variables that facilitate project success: (i) the external environment, including economic, political, and social issues, physical and technological advances; (ii) human-related factors, such as the client's experience, quality vs cost vs time aspirations, and the client's decision-making ability; (iii) project management actions, including the organisational structure, quality assurance programme, communication system, and control of sub-contractors' work; (iv) project procedures, featuring the tendering and procurement approaches; and (v) project-related factors, including the project complexity, size, and type.

In their investigation of the critical success factors that can be applied to enhance projects in terms of their efficiency and effectiveness, Kumara Silva et al. (2016) reported that further empirical study was necessary to explore the relationship between critical success factors related to the management of human resources, and successful project and organisational outcomes in the construction sector. Ramlee et al. (2016) asserted that investigations into critical success factors are necessary to illuminate the route to project success, since such factors will have a direct effect on the outcomes of the project, particularly given the complexity and vibrancy of the construction project environment. Howell (2010) presented a critical success factor achievement model that follows the following six steps: (i) define the goal or objective, (ii) identify the critical success factors, (iii) select the critical success factors, (iv) establish factor components for each critical success factor, (v) measure the progress of the implementation of the critical success factors, and (vi) monitor the progress and take any necessary action. The concept of the critical success factor thus defines those areas where positive outcomes are vital for organisations to realise success for their stakeholders (Jefferies et al., 2002). Therefore, with great value attached to identifying areas that can promote successful project outcomes, this study explores those factors that may be deemed critical to the successful implementation of ISO 9001 in UK construction projects.

Neyestani and Juanzon (2017b) reported that some researchers explored and determined the key construction project objectives as being closely associated with the most essential project management components that are vital for success. Therefore, the management of construction companies should appraise and emphasise the critical success factors, whereby the essential success factors in terms of project management represent the fulfilment of the project's objectives such as completing the project within the cost parameters, on time, and featuring acceptable quality (i.e. the quality triangle).

Ensuring the successful development, implementation, and improvement of QMSs in construction projects is dependent upon a myriad of critical success factors, some of which are associated with the context; for instance, the experience of the project management in terms of projects and quality management, the firm's size and type, as well as the sector of activity (Sadikoglu and Zehir, 2010). The complexity, dynamism or diversity of the environment are all characteristics that must be considered, as well as internal critical success factors such as how human resources are managed, the economic resources available, and components that are project- or project management-specific, alongside the challenges associated with the construction project culture. These can be referred to as critical success factors, or in other words, organisational activities that are vital to realising and improving the performance of the organisation (Jabnoun and Sedrani, 2005).

A range of research has been conducted internationally to address quality-related issues. A hierarchical model for successful construction projects regarding the different project objectives was developed by Chua et al. (1999), where they found that four key project elements influence the quality objective: the contractual arrangements, interactive processes, the project's characteristics, and the project's participants. It was reported that management commitment to ongoing quality improvement, the promotion of high process quality by management leadership, the training of personnel in terms of quality, promoting quality issues at the corporate tier through efficient teamwork, and effective intra-project-party cooperation are generic critical success factors that impact on process quality (Arditi and Gunaydin, 1998). Pheng and Teo (2004) revealed through case studies the potential for the management philosophy that has proved so successful in manufacturing to be repeated in the construction industry context, offering similar advantages in terms of reduced costs, alongside increased quality and employee role satisfaction. It was observed that the quality assurance system applied by the contractor to ensure uniform quality is vital to prevent the manifestation and repetition of issues, while a survey underscored the paucity of quality system documentation for most of the contractor participants (Bubshait and Al-Atiq, 1999). Therefore, quality system documentation should be both developed and enhanced (Rumane, 2018), since the efficiency of all processes can be improved through documentation (Ramaji and Memari, 2015).

Quality improvement methodology was explored by Abdel-Razek (1998), who found the most important element in contributing towards quality improvement to be increased employee satisfaction. Aized (2012) claimed that QMSs feature documentation, guidance, an approach that is systematic, and auditing that can be relevant to the processes of management from the project's beginning to the final stage of completion. Collaborative efforts amongst several organisations are required, which for the project's duration come together to comprise the project team in terms of their capabilities, IT systems, size, skills, and so forth, while these organisations often vary widely (Cox and Townsend, 1999). Despite being typically based in different locations, the importance of their collaboration and project information sharing has been confirmed, and this imposes a great challenge in terms of ensuring enhanced collaborative efforts between the stakeholders of the project to satisfy the client's requirements (Adetunji et al., 2003). The efficiency of the organisational processes can be improved through ISO 9001's documentation and guidance, alongside continual improvement through the aforementioned PDCA methodology in order to realise client satisfaction, as well as the quality objectives. To conform to ISO 9001:2015, projects need to consider the effectiveness in terms of the actions implemented to deal with opportunities and risks; the improvement of processes to prevent nonconformities; the determination, monitoring, and review of applicable parties of interest, as well as their expectations and needs that are pertinent to the construction project's direction and purpose; and determining and maintaining the required knowledge to operate its processes and to realise product and service conformity (Hoyle, 2018).

Applying the ISO 9001 QMS standard in construction projects ensures the consistency of implementation, methodology, and adherence to legislation from a quality perspective, thus assuring a consistently high-quality product. Focusing on the continual improvement of construction projects' implementation of the ISO 9001 QMS standard will ensure the annual improvement of business and associated processes while enabling construction management to analyse their performance with a view to facilitating ongoing improvement through superior planning and subsequently enhanced performance and processes in construction projects, and improved supply chain management and purchasing processes, alongside reduced costs and increased profit margins (Nolan, 2016). Some studies reported that ISO 9001 offers numerous benefits that can optimise construction projects' internal procedures, and while many construction firms have attempted to establish QMSs in their projects by implementing ISO 9001, insufficient work has been undertaken to determine the implementation quality of the ISO 9001 QMS (Farooqui and Ahmed, 2009a).

Construction projects are typically unique endeavours that have become increasingly complex and technical in terms of the design, the construction techniques, and the contractual relationships (Rumane, 2018). Therefore, the incidence of change and its complexity is ever present. ISO 9001:2015 offers guidance on change management regarding measures that can be applied to allow organisations to methodically plan and then modify the QMS in order to enable the timely reaction to changes in circumstances, the client's requirements, the competition, organisational strategies, and the regulatory requirements (Abuhav, 2017). The desired outcome is ensuring that change can be addressed without any negative impact on quality in respect to the emergence of defects and the need for rework or delays (Mukherjee, 2019).

Evidence-based decision-making is defined as a QMP in ISO 9001:2015, as those decisions grounded in the analysis and evaluation of data/ information have a greater likelihood of producing the desired outcomes (Hoyle, 2018). ISO 9001:2015 differs from ISO 9001:2008 in that the earlier version promotes a factual approach to decision-making, while the latter encourages evidence-based decision-making as not all the facts may be available during the decision-making window (Fonseca and Domingues, 2017b).

Client focus remains one of the established QMPs following the revision from ISO 9001:2008 to ISO 9001:2015 (Fonseca and Domingues, 2017b), with Hoyle (2018) asserting that in organisations that are focused on the client, their objective is to fulfil the client's needs and expectations, whereby strong emphasis placed on client focus will result in enhanced client loyalty and increased success. Abuhav (2017) reported that ISO 9001:2015 establishes three primary goals in terms of clients and their expectations of the organisation: (i) the comprehension and implementation of the clients' and regulatory requirements, (ii) developing a strategy that links to the clients' needs and expectations, and (iii) producing an outcome (product/ service) that meets the clients' and regulatory requirements.

Anttila and Jussila (2017) discussed the advantages and challenges of standardisation in the context of ISO 9001:2015. They cited the advantages as (i) enabling the general acceptance and dissemination of the requirements, (ii) the broad skill-base applied to the preparation of the standard, (iii) the widespread commitment and recognition, and (iv) the ability to implement the requirements innovatively; while the disadvantages include (i) the comprehensibility issues that arise when individuals from different cultures engage in creating the requirements, (ii) weak management of the standardisation, (iii) the final content being decided upon by consensus, and thus leading to omissions, (iv) certain individuals potentially dominating the decisions, (v) the slow nature of standardisation and the time necessary to address issues, and (vi) the high cost involved in participating in standardisation.

In terms of the engagement of people QMP, Fonseca and Domingues (2017b) reported a shift from the passive 'involvement of people' in ISO 9001:2008 to the more active 'engagement of people' in ISO 9001:2015, where the change in terminology implies stronger participation as well as the focus on competence. Moreover, there is a requirement for personnel that are competent, empowered, and engaged organisation-wide in order to increase its value creation and delivery capability (Fonseca and Domingues, 2017b). The belief is that engaged people will align with their leadership, where the personnel experience a personal and emotional connection to the organisation, and a closeness to its actions, ethics, and values (Hoyle, 2018).

Hoyle (2018) asserted that an organisation's culture, motivation, and vision emerge from the leadership, with leaders creating the vision through their decision-making and action, which consequently drives the motivation of the personnel. Mukherjee (2019) reported that under ISO 9001, leadership generates the organisational momentum and direction, creating an internal environment through which personnel can fully engage with the achievement of the organisational objectives. Under this ISO 9001:2015 QMP, leaders are required to provide evidence of their commitment, such as practising and demonstrating leadership, establishing a quality policy and objectives, and ensuring the effectiveness of the QMS (Abuhav, 2017).

Fonseca (2015) stated that while the system approach to management can be found under the ISO 9001:2008 version, in the ISO 9001:2015 version, systems and processes are now located under the process approach QMP, which addresses how related processes can be managed. The 2015 standard harnesses the process approach to allow the organisation to plan its processes and the associated interactions in an effective manner, with the organisation's effectiveness being dependent upon its ability to simultaneously carry out a range of interconnected actions in order to realise the required outcomes, namely the client's expectations (Abuhav, 2017).

Previously identified as 'mutually beneficial supplier relationships' under ISO 9001:2008, the relationship management QMP emerged in ISO 9001:2015 (Fonseca, 2015). Hoyle (2018) described organisations applying this principle as those who (i) comprehend which relationships are essential for success, and aim to understand their needs and expectations; (ii) recognise which relationships may threaten success, and strive to minimise their impact; (iii) develop short-term and long-term relationships; (iv) ensure clear and transparent communication; (v) share information and future plans where appropriate; and (vi) recognise the achievement of those who have contributed to the organisation's success.

Hola (2015) evaluated the processes implemented in a construction organisation, where the analysis identified the frequent turnover of employees, which may have eroded the levels of quality. Therefore, additional internal training was recommended to include all employees in those processes evaluated. Adetunji et al. (2003) reported on the need to educate staff members on the importance of teaching the aims and characteristics of quality. Moreover, skills and training are an important component to consider, with Willar et al. (2015) asserting the need to enable learning, with personnel trained in terms of quality. Regarding the quality aims and characteristics, these should be delivered to the personnel through training seminars and then shared throughout the organisation (Chiarini, 2017).

The continuous improvement QMP defines the longer-term objectives of the organisation regarding performance, whereby the organisation should apply a comprehensive approach and ensure that every individual is focused on the objective of continuous improvement (Manders et al., 2016). It should be underscored that rather than representing an activity, improvement is actually an outcome or objective. Therefore, while activities can be planned and implemented to achieve improvement, it is only through the evaluation of the outcome(s) that they can be found to have created enhanced improvement (Hoyle, 2018).

From the discussions found in the literature, the researcher has identified the most common critical success factors for effective implementation of the ISO 9001 QMS in construction projects to allow a theoretical base for this study to be established, as presented in Table 3.4 below.

Table 3.4: The critical success factors for effective implementation of the ISO 9001 QMS

Critical success factor	Factor component	Reference
Change management	Determine the needs and expectations of stakeholders	Abuhav (2017)
	Monitor the needs and expectations of stakeholders	Abuhav (2017)
	Promote continual improvement	Rumane (2018)
	Plan for change	Hoyle (2018)
Evidence-based decision-making	Analyse data through appropriate methods	Medić et al. (2016)
	Use the analysis of processes data to inform decisions	Anttila and Jussila (2017)
	Evaluate the effectiveness of actions taken to address risks	Fonseca and Domingues (2017b)
	Evaluate the effectiveness of actions taken to address opportunities	Fonseca and Domingues (2017b)
	Monitor performance	Willar et al. (2015)
	Measure performance	Mansour et al. (2019)
	Analyse performance	Neyestani and Juanzon (2017a)
	Conduct internal audits	Hoyle (2018)
	Evaluate individual performance	Hoyle (2018)
	Ensure access to exact and reliable data	Fonseca and Domingues (2017a)
	Strike a balance between practical experience and data analysis	Medić et al. (2016)
Client focus	Understand the current clients' requirements	Luburić (2015)
	Understand future clients' requirements	Luburić (2015)
	Measure client satisfaction	Hoyle (2018)
	Exceed client expectations	Willar et al. (2015)
	Focus on the intangible advantages to increased client satisfaction	Shaari et al. (2015)
	Ensure the project objectives match the client's requirements	Fonseca and Domingues (2017b)
	Ensure the project objectives match the client's expectations	Fonseca and Domingues (2017b)
Non-standardisation	Develop quality system documentation	Rumane (2018)

	Enhance quality system documentation	Rumane (2018)
	Improve the efficiency of processes through documentation	Ramaji and Memari (2015)
Engagement	Facilitate the open discussion of issues	Fonseca and Domingues (2017b)
	Facilitate the open discussion of barriers	Mansour et al. (2019)
	Enhance the motivation of personnel	Mansour et al. (2019)
	Promote quality issues through efficient teamwork	Willar et al. (2015)
	Increase employee satisfaction	Röyttä (2016)
	Ensure that employees' abilities are utilised	Röyttä (2016)
	Ensure that employees' abilities are valued	Röyttä (2016)
Leadership	Establish a vision for the project	Medić et al. (2013)
	Establish a pathway for the project	Medić et al. (2013)
	Empower employees	Neyestani and Juanzon (2017b)
	Equip employees	Neyestani and Juanzon (2017b)
	Create trust with employees	Chiocchio et al. (2011)
	Ensure commitment to the role	Mansour et al. (2019)
	Ensure commitment to policy	Jabnoun and Sedrani (2005)
	Ensure responsibility to project partners	Sitnikov and Bocean (2015)
	Reduce the environmental impact	Sadikoglu and Zehir (2010)
	Identify challenging targets	Sickinger-Nagorni and Schwanke (2016)
	Promote high-quality processes	Fonseca and Domingues (2017b)
	Ensure the efficient use of resources	Jabnoun and Sedrani (2005)
Process approach	Manage activities as processes	Sickinger-Nagorni and Schwanke (2016)
	Reduce activities that add no value	Sickinger-Nagorni and Schwanke (2016)

	Reduce processes that add no value	Mansour et al. (2019)
	Conduct audits of processes	Mansour et al. (2019)
	Improve processes to prevent nonconformities	Wilson and Campbell (2016)
	Determine the knowledge necessary for the operation of processes	Jabnoun and Sedrani (2005)
	Maintain the knowledge necessary for the operation of processes	Sickinger-Nagorni and Schwanke (2016)
	Take action to address risk	Dumitrascu and Nedelcu (2012)
	Take action to exploit opportunity	Mansour et al. (2019)
	Gauge the feasibility of activities	Aized (2012)
	Determine links between activities	Chiarini (2017)
Relationship management	Share information with stakeholders	Sickinger-Nagorni and Schwanke (2016)
	Share plans with stakeholders	Hoyle (2018)
	Share resources with stakeholders	Chiarini (2017)
	Share expertise with stakeholders	Anttila and Jussila (2017)
	Cooperate in the development of activities	Hoła (2015)
	Establish effective intra-project-partner cooperation	Moracanin (2012)
	Manage effective intra-project-partner cooperation	Manders et al. (2016)
	Establish short-term relationships	Mansour et al. (2019)
	Establish long-term relationships	Mansour et al. (2019)
Skills and training	Train personnel in terms of quality	Willar et al. (2015)
	Share knowledge	Shaari et al. (2015)
	Enable learning	Willar et al. (2015)
	Share the quality aims and characteristics	Chiarini (2017)
	Teach the quality aims and characteristics	Chiarini (2017)
	Manage communication	Shaari et al. (2015)

	Improve communication	Shaari et al. (2015)
Continuous improvement	Provide resources for continuous improvement	Hoyle (2018)
	Manage resources for continuous improvement	Hoła (2015)
	Provide documentation for corrective action	Anttila and Jussila (2017)
	Enable the project team to participate in improvement	Mansour et al. (2019)
	Conduct operational planning	Mansour et al. (2019)
	Conduct operational control	Chiarini (2017)
	Identify the requirements	Hoyle (2018)
	Measure improvement consistently	Shaari et al. (2015)
	Analyse performance	Willar et al. (2015)
	Celebrate improvement	Anttila and Jussila (2017)
	Develop a reward system	Chiarini (2017)

The critical success factor elements identified from the literature review are presented in Table 3.4 above. Although these factors are not exclusively specific to the UK, or to construction projects, the researcher perceives that they are applicable to the effective implementation of the ISO 9001 QMS in UK construction projects. Moreover, these critical success factors identified in Table 3.4 provide remedies for many of the issues hindering the effective implementation of ISO 9001 in construction projects, as highlighted in Table 3.3. For example, the issue of quality being jeopardised when a project's plan is changed during construction (Leonard, 2010) is addressed by determining the needs and expectations of the stakeholders (Abuhav, 2017) and planning for change (Hoyle, 218); the lack of management commitment (Boiral, 2011) can be overcome by establishing a vision and a pathway for the project (Medić et al., 2013); construction projects being often characterised by a lack of standards (Bawane, 2017) can be remedied by developing and enhancing quality system documentation (Rumane, 2018); limited technical awareness in terms of quality management (Rybski et al., 2017) can be addressed by training personnel in terms of quality (Willar et al., 2015); and the nature of construction as a highly complex process involving myriad partners (Love et al., 1998) can be remedied by sharing information (Sickinger-Nagorni and Schwanke, 2016), plans (Hoyle, 2018), resources (Chiarini, 2017) and expertise (Antilla and Jussila, 2017) with the stakeholders. Essentially, whereas Table 3.3 presents the challenges to effective implementation of the ISO 9001 QMS, in Table 3.4 this study establishes a range of critical success factors and factor components to promote effective implementation of the QMS that are grounded in the literature and offer remedies for the issues identified. Therefore, the range of indicators have been identified as suitable for adoption by construction projects to facilitate the measurement of the ISO 9001 QMS's implementation and its impact on the performance of UK construction projects. The Project Management Institute (2013) asserted that the management of a project typically includes, but is not limited to, (i) identification of the project's requirements; (ii) attending to the various concerns, expectations and needs of the stakeholders; (iii) establishing and maintaining clear, effective and collaborative communication with the stakeholders; (iv) ensuring that the project's requirements are met, and that the project is delivered; and (v) striking a balance between the project's constraints in terms of the budget, resources, risks, schedule, scope, and quality. Moreover, the project manager's role can include evaluation and analysis processes before the project begins, and may vary between organisations, whereby the role of project management is tailored to the requirements of the organisation, as are the project management processes tailored to meet the requirements of the project (Project Management Institute, 2017).

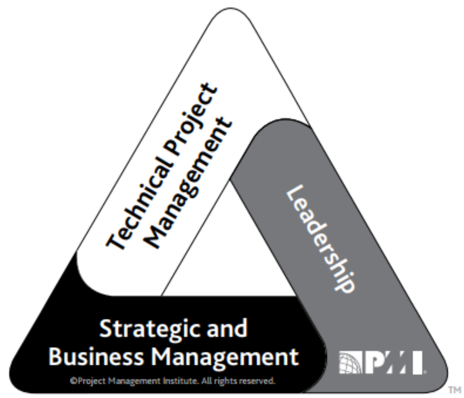

Figure 3.10: The PMI Talent Triangle (Project Management Institute, 2017)

Figure 3.10 exemplifies the broad scope of the project manager in terms of the technical project engagement, leadership and strategic business management, and this study argues that the provisional critical success factors identified by this study to support the effective implementation of the ISO 9001 QMS in UK construction projects and presented below, all fall within the diverse responsibilities of contemporary project management:

(1) Change management

(2) Evidence-based decision-making

(3) Client focus

(4) Reduce the impact of non-standardisation

(5) Engagement of people

(6) Leadership

(7) Process approach

(8) Relationship management

(9) Skills and training

(10) Continuous improvement

These ten critical success factors emerged from the literature as being pertinent to influencing performance; therefore, in terms of construction project performance, the literature suggests that the critical success factor elements will have a significant and positive impact. Consequently, they may require additional attention from project managers in order to apply those constructs that will increase the organisational performance. This will be verified in the subsequent investigation stage by presenting these results (secondary data) through a questionnaire containing these critical success factors and components, which will be distributed to the project managers of UK construction projects. The identified critical success factors are depicted visually in Figure 3.11 below.

Figure 3.11: The critical success factors for effective implementation of the ISO 9001 QMS

3.10 Conclusion

This chapter began by describing the characteristics of construction projects, before reviewing definitions presented in the literature in terms of the concept of quality, including Taylor, Shewhart, Deming, Juran, Crosby, Feigenbaum, and others, in order to acquire a grounding in the theory of the ISO 9001 QMS. A review of QMSs including Lean Management, Six Sigma and TQM followed, with their progress and global experience presented to evaluate the extent of the shift towards quality and what can be learned or represents transferrable knowledge. A discussion of ISO 9001's history and development was then presented, with the aim of integrating quality management standards that have similar characteristics into one international body for quality standards that would be applicable to world trade. The literature related to the ISO 9001 QMS in the construction industry was also explored, while a description of the construction industry was provided, as well as the industry's challenges. Furthermore, it was identified that despite the clear advantages of the ISO 9001 QMS, difficulties present that can hinder effective implementation. These issues and the challenges of effective QMS implementation that emerged, underscore the importance of this study in terms of empirically establishing the critical success factors for effective ISO 9001 implementation that can address and negate these weaknesses.

In light of the literature reviewed on the status of the ISO 9001 QMS and its implementation in construction projects, a series of critical success factors for its implementation was identified, which were justified as falling within the role of the modern project manager. Nevertheless, the findings emerging from the literature in terms of the status of the ISO 9001 QMS's implementation in construction projects in the UK are limited. Therefore, this research proposes the collection of primary data to gather perceptions associated with the ISO 9001 QMS's implementation in the UK's construction industry. The findings will be combined with the secondary data from the literature, which will lead to the next stage of identifying the critical success factors to support ISO 9001 implementation in UK construction projects. The following chapter considers the research methodology, and presents the research procedures, approaches and techniques that relate to data collection and analysis, and are vital to enable a data collection methodology to be developed for this study.

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Chapter 4

Research Methodology

4.1 Introduction

This chapter discusses the research methodology employed to ensure that the aim and objectives of this study can be achieved, and thus the research question can be answered, namely: What are the critical success factors for the implementation of the ISO 9001 QMS to achieve successful outcomes in UK construction projects? Therefore, determining the theoretical methodology that underpins the research and leads to the appropriate method to investigate the phenomenon is of vital importance.

This chapter begins by considering the research methodology, and then proceeds with a discussion of the research philosophy in terms of the ontological, epistemological and axiological assumptions. The philosophical stance of the researcher is then established, followed by the establishment and the justification for the approach utilised for this study. The qualities of quantitative, qualitative and mixed methods research are then considered, before the options for the research strategy are explored, and the research strategy assumed for this study established. Consideration of the time horizon is made, as well as the research techniques available, the options for data sampling, collection, and analysis. Then, the sampling approach and strategy applied in this study are presented. By the end of this chapter, the research methodology and strategy will be established, enabling the data collection to proceed in the next stage of the study.

4.2 Research methodology overview

Saunders (2015) stressed that the research design should provide a clear description of the plan for how to respond to the research objectives, with justification for the strategies selected and used in a specific report. Neuman (2014) asserted that the research methodology is grounded in epistemological and ontological assumptions, which once understood can assist the researcher to not only better comprehend the bases of the debate among social scientists, but also to develop themselves through awareness of their assumptions and ensuring that these are made explicitly. Through the research process, the researcher will make ontological assumptions regarding the realities found during the research process, epistemological assumptions about human knowledge, and axiological assumptions about how the researcher's values impact on the research process (Saunders et al., 2016). Robson and McCartan (2016) described the adoption of a scientific approach as being to conduct research (i) ethically, to cause no harm to the participants involved; (ii) sceptically, to ensure that all observations and conclusions are scrutinised; and (iii) systematically, by giving deep consideration to what and how the research is conducted, as well as the role of the researcher in the observations made. The research design was characterised by Yin (2014) as a logical plan for arriving at a specified destination, where the departure point could be said to represent the underlying research questions, and the destination point at which these have been responded to and thus conclusions can be drawn. This chapter provides a rationale for the epistemological stance adopted in studying that reality, while describing and justifying the methodology employed to investigate QMSs in construction projects and to define the critical success factors necessary to support implementation. This involves not only detailing how the data will be collected, but also the techniques of analysis that will be employed to interpret that data. In the view of Kagioglou et al. (2000), the research methodology is recognised as a significant feature of the nested model, which facilitates a simple understanding of the research methodology elements, as described in Figure 4.1.

Figure 4.1: Nested research design (Kagioglou et al., 2000)

4.3 Research philosophy

The research philosophy implies a system of assumptions and beliefs regarding knowledge development, whereby in the social sciences this typically relates to answering a particular research question, and thus contributing to knowledge (Saunders et al., 2016). Gaining an understanding of the research philosophy is essential, as it contains vital assumptions regarding the researcher's perspectives (Saunders, 2015) that will inform the selection of the research strategy and design to identify appropriate research methods and techniques. Easterby-Smith et al. (2015) presented four reasons to explain the importance of understanding philosophical issues: (i) the researcher must comprehend the essential epistemological issues in order to gain clarity over his or her role in the research methods; (ii) it will assist in the clarification of the research design, in terms of what evidence needs to be collected, and how this could be gathered and analysed; (iii) which designs will work and which will not can be understood; and (iv) the researcher may be able to identify potentially useful designs beyond his or her normal range of experience. Saunders (2015) reported that the philosophy of research is related to extending and enhancing the body of knowledge, while Neuman (2014) cautioned that the majority of researchers expend their efforts on developing the necessary skills to employ their selected research technique(s), as opposed to conducting deep consideration of the nature of empirical research. Exploring the research philosophy thus requires the researcher to consider their beliefs of the world that surrounds them, to determine what comprises desirable or acceptable knowledge, and to what degree they feel they should remain discrete from their data (Saunders et al., 2016). Moreover, Saunders et al. (2016) asserted that to investigate and understand the research philosophy, the researcher must question their own actions and thoughts, and learn to scrutinise their beliefs in the same manner that they would those of others, namely, to develop the skill of reflexivity.

Robson and McCartan (2016) discussed the influence of postmodernism on social research, and while the modernism that emerged during the scientific developments from the sixteenth century onwards aspired to objectivity, general truths and rationalisation, postmodernism rejects any basis for the assertions of 'truth', particularly within the social sciences where the subjects are people who have their own particular ideas and meanings attached to what unfolds around them. Postmodernism thus provides a critique for the progression of science, implying that this is not always continuous, linear and optimum (Easterby-Smith et al., 2015). In terms of research, postmodernists perceive organisations as being dynamic and under constant change (Easterby-Smith et al., 2015).

To comprehend the philosophy of research thoroughly, Easterby-Smith et al. (2015) noted the importance of fulfilling the following criteria:

- Explain the research design.
- Recognise which designs will function well, and which will not.
- Determine the design, and possibly generate a new one that may fall outside the past experience of the researcher.

With the intention of explaining the research methodology's layers, the 'research onion' was developed by Saunders (2015) as a model, which is illustrated in Figure 4.2 below.

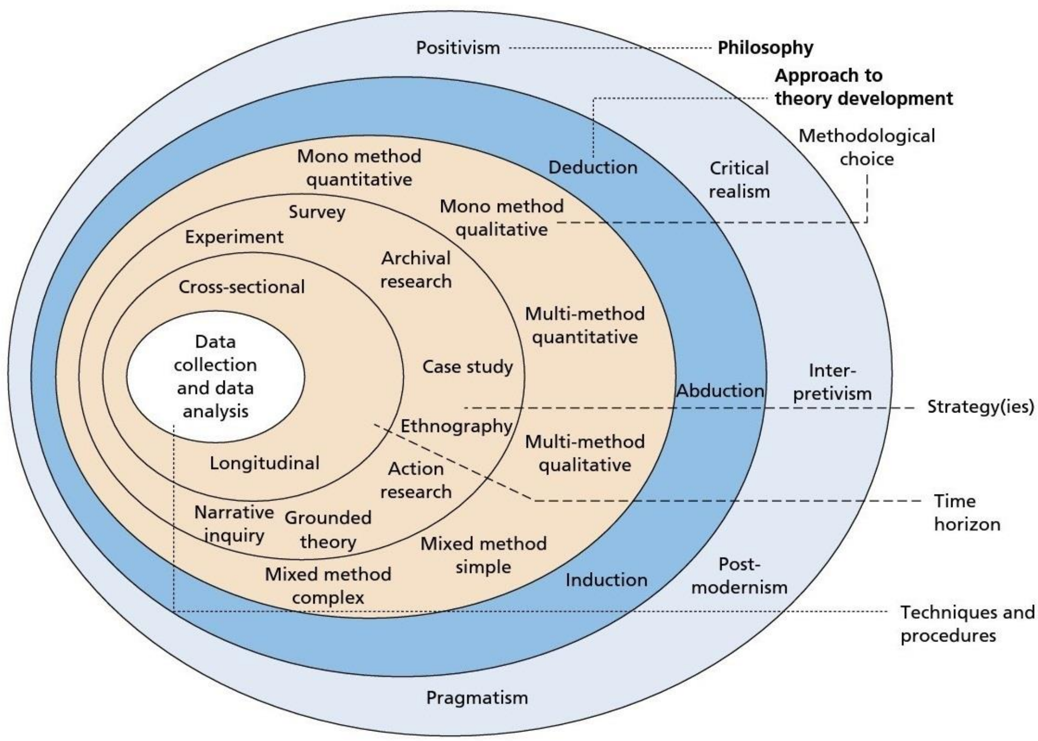

Figure 4.2: The Research Onion Model (Saunders, 2015)

Their research onion model helps the researcher to determine not only how to collect the data, but also why the choices to collect in that way are made, so that the research can be perceived as having a philosophical grounding, and be perceived as credible by others (Saunders et al., 2016). Therefore, consideration for the outer layers of the onion (i.e. the research philosophy and the approach to theory development) are vital to provide credibility to the inner layers that focus on the data collection and analysis.

Saunders et al. (2016) described a central philosophical debate in terms of ontology versus epistemology, whereby ontology refers to the nature of existence and reality, while epistemology describes the theory of knowledge and how researchers can best make their enquiries. Then, axiology signifies the role of ethics and values in research. These philosophical assumptions will now be considered.

4.3.1 Ontology

Ontology was identified by Saunders (2015) as the researcher's perspective(s) on the notion of reality, since researchers can examine and analyse phenomena and draw their own conclusions. Ontology entails studying what it means to exist and what reality consists of: positivists believe that the world exists independently of our knowledge, while relativists assert that there are numerous realities and opportunities to access them (Gray, 2014). In terms of positivism, the world exists independently of our knowledge of it, while in terms of relativism, multiple realities exist, as well as the means of accessing them (Gray, 2014). Easterby-Smith et al. (2015) described a key ontological debate as being realism and relativism, whereby realism assumes that the world is external and concrete, while relativism asserts that scientific laws are not simply waiting to be found, but rather that they are created by people through research, discussion and agreement. According to Saunders (2015), ontology has two extreme views: objectivism and subjectivism. The objective stance regards the nature of the realities of the world as being external to the researcher's own mind, while the subjective stance asserts that reality is constructed in the social domain and thus can only be fully comprehended by testing the human actors' perceptions. Gray (2014) asserted that the objective stance places reality independently of consciousness, where the researcher should strive to avoid inclusion of his or her values and feelings. Ontological assumptions were reported by Johnson and Duberley (2000) to include two aspects: realism and idealism. Objectivity links to realism, considering that entities exist independently of how we may perceive them, while idealism can be more closely associated with subjectivity (Saunders et al., 2016). Bryman (2012) discussed ontology in terms of objectivism and constructionism, where the former implies that social phenomena are facts that we cannot influence, while the latter asserts that social phenomena are formed and modified by social actors. To conclude, ontology represents our perspective(s) on the nature of reality, namely, an existing objective reality, or merely a conceived and subjective reality (Flowers, 2009).

4.3.2 Epistemology

The second branch of philosophy is epistemology, which as suggested by Saunders (2015) expresses the researcher's view concerning an original creation and the diffusion of what represents acceptable knowledge in a particular domain of research. Therefore, epistemology includes an examination of relationships among the researcher and the focus of the research (Collis and Hussey, 2013). Gray (2014) asserted that epistemology attempts to comprehend what it means to know, by generating a philosophical foundation for determining what types of knowledge are sufficient and legitimate. Despite the broader choice of methods available when conducting business and management research, Saunders et al. (2016) encouraged careful consideration of the implications of the various epistemological assumptions associated with the choice of method, since each will offer strengths and limitations to the research findings that result. It is possible to classify the epistemological philosophy of research into two realms: positivism or interpretivism, and realism (Saunders, 2015).

Positivism is a position of epistemology that encourages the application of methods employed in the natural sciences in order to explore social reality, while including the following principles: (i) the only real knowledge is that which can be confirmed by the senses; (ii) theory enables the generation and testing of hypotheses; (iii) knowledge is attained through the collection of facts; (iv) science must be conducted in an objective manner; and (v) scientific statements represent the ultimate territory of the scientist (Bryman, 2012). Positivism argues that theory is utilised to improve hypotheses that will be examined and tested, leading to the extension or development of theory. Eventually, this stance may generate links among a range of subject variables and enable their relation to a particular theory (Neville, 2007). In terms of the interpretivist approach, the aim is to understand the differences between conducting research on people rather than objects, with there being differences among humans as social actors (Saunders, 2015). The assumption of this perspective is the strong likelihood that people will influence events and behave unpredictably, using qualitative patterns to induct and comprehend experiences in specific contexts. Gray (2014) described interpretivism as an anti-positivist position, which asserts that since there are differences between the natural and social reality, they must be investigated by different methods. Easterby-Smith et al. (2015) described the epistemological debate between positivism and social constructionism, whereby in positivism the observer is independent, the research progresses through hypotheses and deductions, and explanations must be demonstrated through causality; while in social constructionism, the observer is part of that being observed, the research progresses through the collection of rich data, and explanations are intended to enhance our understanding of the focus of interest. The theory of realism is grounded in a reality that is absolutely independent of the mind. Essentially, idealism, which posits that solely the mind's perceptions exist, is opposed by realism, whereby realism is an epistemological branch that shares similarity to the scenario, as the development of knowledge through a scientific approach is assumed (Saunders, 2015).

4.3.3 Axiology

Axiology is the third philosophical strand, with the term derived from the Greek *axios*, which denotes value or worth. In terms of research, axiology involves questions of how the researcher addresses the role of his or her values, as well as those of the participants (Saunders et al., 2016). Saunders (2015) reported that the importance of axiology is involving all stages of the research process. Here, axiology can be classified based on whether the reality is free of values, or rather it is value driven (Pathirage et al., 2005). This philosophy contributes towards the improvement of the research methodology as it prescribes the position and role of the researcher who collects implicit values, experiences and beliefs during the research, particularly for approaches that are aligned with an interpretivist epistemology, as reported by Easterby-Smith et al. (2008). Value-free research makes the assumption that the study is independent from the data, and thus it becomes objective. Otherwise, the bound values are related when the researcher cannot isolate him or herself from the phenomenon, in which case it will become subjective (Jaya, 2014).

4.3.4 The philosophical position of the research

This research seeks to determine the critical success factors for effective implementation of the ISO 9001 QMS in UK construction projects. In this context, and in light of the philosophical stances considered above, positivism was selected as the research philosophy to underpin this study as it seeks to employ theory in order to investigate the research phenomenon in a highly structured and replicable manner, where the focus will be placed on generating observations that are quantifiable and can be statistically analysed (Saunders et al., 2016), leading to the future extension of theory and the provision of recommendations to enhance the ISO 9001 QMS's application in UK construction projects, and thus to accomplish the aim of this research. Moreover, the researcher will be independent, and the study needs to test the critical success factors and factor components that emerged from the literature, as opposed to gathering rich data from which to induce ideas (Easterby-Smith et al., 2015). Also, the researcher believes in conducting empirical and value-free research, which is compatible with positivist social science (Neuman, 2014). Furthermore, the objective approach is more suitable in terms of the ontological assumptions followed by positivism, due to the involvement of a range of actors in this process. Eventually, this stance will generate links among a range of subject variables and relate them to a specific theory. An additional pertinent element of research through the positivist approach is that, insofar as is possible, research is conducted in a manner that is free of value, as the researcher will remain independent and distinct from the subject matter (Saunders, 2015), with a realism that stands opposed to idealism. The philosophical position concerning the research is described in Figure 4.3, whereby it can be seen that the researcher's ontological position embraces realism, with the subjects of the research existing independently of how he or she perceives them (Saunders et al., 2016); the epistemological stance is positivism, as the researcher is believed to be located apart from that which is being observed (Easterby-Smith et al., 2015); and the axiological stance is free from the influence of the researcher's values (Easterby-Smith et al., 2015).

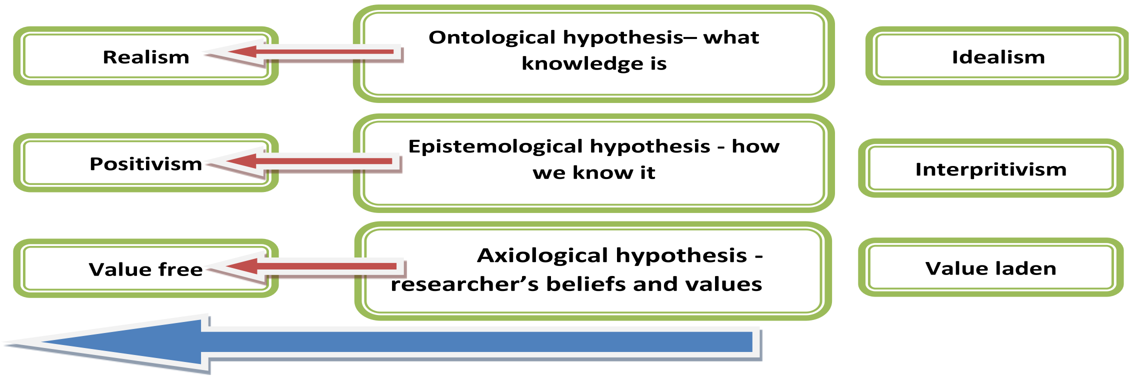

Figure 4.3: The philosophical position in this research

4.4 Research approach

In Saunders's (2015) view, the research approach is significant as it increases the researcher's potential to respond successfully to particular research questions while facilitating in fulfilling the study's objectives, with three research-type approaches possible: deductive, inductive, and abductive. The deductive approach concerns improving a hypothesis and theory; therefore, the designing of such a research strategy should first be developed to examine the hypothesis, after which the principle is approved, rejected, or amended. The hypothesis will be expressed as an assertion regarding two or more variables and their inter-relationships. Hence, the fundamental process would involve the identification of several variables, which would be investigated via practical observation (Ary et al., 2018). Conversely, the inductive approach is pertinent to data collection to enable the development of theory through data analysis (Bryman, 2016). Employing the inductive approach has a greater likelihood of being involved with the context of events that are taking place. Ultimately, Saunders (2015) reported that studies with a small sample size may be more suited to the deductive approach than those with larger samples, and continued by stating that the abductive approach combines the deductive and inductive approaches (Saunders, 2015).

Progressing a methodically tested theory defines the deductive approach, one which is commonly employed for an ontology that is both objectivist and widely utilised within the natural sciences, where Ary et al. (2018) reported the laws as reflecting the root of comprehending a phenomenon.

Hypothesis expansion is typically driven by a theory's early development, which is subsequently tested to facilitate in the validation or additional modification of the theory. Bryman (2016) believed that deductive thinking focuses from the broad to the specific, which has been referred to as a methodology that is 'top-down' in nature (Behfar and Okhuysen, 2018). The initial stage requires the identification of a theory that is associated with a subject of interest, which is then refined to a more defined hypothesis with the potential to be assessed prior to additional refining through the collection of observations to test the hypothesis. Saunders (2015) asserted that the eventual outcome is the testing of hypotheses with certain data that assist in either the confirmation or rejection of the original theory.

Ary et al. (2018) described the inductive approach as one that features perceptions that serve to promote hypothesis development, where the consideration of observations regularly occurs within the phenomenon's setting. Subjectivist ontologists often employ this 'bottom-up' approach that travels from the specific to the general, with inductive reasoning commencing by navigating from specific observations towards theories and generalisations that are broader (Saunders, 2015). Consequently, the process commences with specific observations, and through these the researcher begins to identify sequences, generates certain tentative hypotheses for exploration, and eventually reaches a number of theories or conclusions (Bryman, 2016).

Walton (2014) argued that the origins of the abductive approach can be found in the notion that the greatest advances in science did not result from absolute deduction or induction. Therefore, blending both approaches (i.e. through deductive and inductive research) may produce results of a more significant nature. Moreover, the abductive approach can lead to greater creativity and intuition, while differing abductive research streams can be found in modern science (Behfar and Okhuysen, 2018) with a range of disciplines featuring abductive reasoning, where each field has specifically extended the approach, with those disciplines that adopt abductive reasoning (i.e. blending deduction and induction) ranging from language acquisition, linguistics and logic, to artificial intelligence, computer science, and neural networks, among others (Woo et al., 2017).

To summarise, deductive reasoning can generally be employed to test hypotheses in order to progress theory, it travels from the general to the specific, and is often associated with positivist philosophy to enable generalisation to be achieved through statistical probability (Easterby-Smith et al., 2015); inductive reasoning relates to constructing theory, travels from the specific to the general, and is often associated with interpretivist philosophy; while abductive reasoning blends deductive and inductive reasoning, with the potential for results that are more significant to emerge.

To clarify and comprehend the actual differences present across the deductive, inductive and abductive types in the context of the research approach, the logic, generalisability, and the application of the data and theory should be considered (Saunders, 2015), as seen in Table 4.1 below.

Table 4.1: Deduction, induction and abduction (Saunders, 2015)

	Deduction	Induction	Abduction
Logic	In a deductive inference, when the premises are true, the conclusion must also be true	In an inductive inference, known premises are used to generate untested conclusions	In an abductive inference, known premises are used to generate testable conclusions
Generalisability	Generalising from the general to the specific	Generalising from the specific to the general	Generalising from the interactions between the specific and the general
Use of data	Data collection is used to evaluate propositions or hypotheses related to an existing theory	Data collection is used to explore a phenomenon, identify themes and patterns and create a conceptual framework	Data collection is used to explore a phenomenon, identify themes and patterns, locate these in a conceptual framework and test this through subsequent data collection and so forth
Theory	Theory falsification or verification	Theory generation and building	Theory generation or modification; incorporating existing theory where appropriate, to build new theory or modify existing theory

4.4.1 Justification for the selected research approach

In this research, the deductive approach will be employed to determine the critical success factors based on the literature, testing, interpretation of the causal relationships that exist amongst concepts and variables, and the measurement of quantitative concepts. Collis and Hussey (2013) asserted that the conclusion owes a significant debt to scientific research, including the development of rigorously tested theory. Thus, in the field of the natural sciences, it is the prevailing research approach, where the basis of interpretation is represented by laws that enable phenomena to be predicted, and therefore to be controlled. The study will follow Saunders et al.'s (2016) sequential approach by using the existing literature to test a number of propositions (i.e. the critical success factors and factor components that emerged in Table 3.4) by collecting data to allow measurement and analysis, and finally to determine whether the data presented in Table 3.4 holds true, or modifications are required. The reason behind this study is to identify the critical success factors for the effective implementation of the ISO 9001 QMS in UK construction projects. In this study, a deductive style is already in operation because the deductive reasoning works from the general to the specific. With the wider idea of the ISO 9001 QMS presented in the business environment in general, including the benefits and challenges, and the focus placed on the multiple aspects of the construction projects, this study considers the challenges facing the implementation of the ISO 9001 QMS in construction projects and the benefits of adopting it in a specific geographical context, namely the UK. In other words, there will be a gradual transition from the theory of ISO 9001 QMS adoption in construction projects to the field where data will be collected, an approach described by Saunders (2015) as a deductive. Moreover, by following Bryman's (2012) process of deduction presented in Figure 4.4 below, this study explores the theory behind ISO 9001 implementation in Chapter 3, and then draws critical success factors from this theory. After that, the study will collect data and conduct analysis in order to confirm or reject the critical success factors from the literature, and finally to revise the theory if applicable.

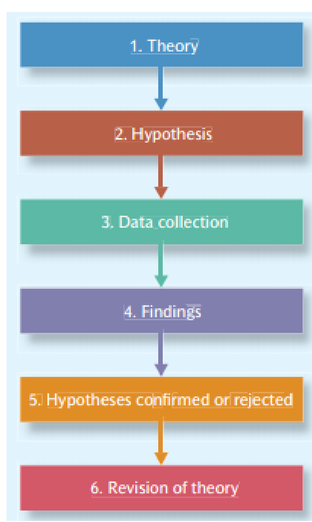

Figure 4.4: The process of deduction (Bryman, 2012)

4.5 Research choice

According to Saunders (2015), two primary categories exist in terms of the research choice: (i) the mono method, and (ii) the multiple method. The former refers to employing a singular technique for data collection, together with its respective data analysis steps, whilst the multiple method by definition implies two or more techniques for the collection of data and the associated analysis steps that are employed to respond to the research questions. Furthermore, multi methods have been categorised into multi-method and mixed-method techniques, where the former refers to employing more than one method in a single study (either qualitative or qualitative) and conducting analysis of the resulting data in correspondence with the respective procedures, while the mixed method points to employing data-collection techniques from both the qualitative and quantitative domains, with the subsequent analysis conducted within a single research design.

4.5.1 Quantitative (mono) method

Quantitative research can typically be described as employing the analysis of statistics in order to illuminate the connections between existing knowledge and that which can be acquired by conducting research. Data collection and analysis through quantitative approaches necessitates comprehending the relationships that may exist among variables through descriptive statistics, utilised to allow inferences and estimate parameters about populations (Creswell and David, 2017), or inferential statistics grounded in statistics that are descriptive, and generalisable assumptions (Yin, 2018). The data can be visualised through graphs, charts, plots and tables in quantitative analysis, while for quantitative researchers the conclusions are reached through argument, evidence, and logic (Saunders, 2015). To assess the claims presented and to evaluate the validity of the instrument, the raw data are interpreted and moderated by the overall guidelines. Moreover, protocols are utilised in quantitative analysis to manage or predict validity threats, insofar as is reasonably possible.

4.5.2 Qualitative (mono) method

Qualitative research can be described as an investigation carried out in authentic settings, where the researcher essentially plays the role of the data collection instrument though gathering the participants' utterances or behaviour, analysing them to identify recurring themes by focusing on the expressed meaning, and then producing a description of the process with language that is both expressive and persuasive (Fellows, 2015). Jaya (2014) defined qualitative study as educational research where the reliance is placed on the views of the participants; wide-scoped and generalised questions are posed; largely word- or text-based data are gathered; descriptions and analyses are presented as themes; and the inquiry is carried out in a manner that is both biased and subjective. Qualitative research is typically reported to engage with thinking or reasoning that is inductive as it travels from particular observations regarding specific instances to more general theories and generalisations. Through employing the inductive approach, the researcher commences with particular observations and measurements before identifying the patterns and themes emerging from the data, thus enabling initial hypotheses to emerge that can be investigated and may ultimately result in findings in the form of theories or conclusions (Saunders, 2015).

It has been assumed that both quantitative and qualitative research deal with identical components within the research process (Creswell, 2014); however, differences manifest through the manner in which researchers engage with the particular stages, such as how they use the literature, focus the intent, and collect, analyse, and validate the data, along with the role of the researcher.

Bryman (2016) underscored a number of common differences in the context of quantitative and qualitative research (see Table 4.2), which include quantitative research involving numerical data, and an objective researcher detached from the research subjects, resulting in statistical data and generalisable results. Conversely, qualitative research involves spoken words and observations, and a subjective researcher immersed in the research setting, resulting in deep, rich data and findings specific to the research setting.

Table 4.2: Quantitative vs qualitative research (Bryman, 2015)

Quantitative	Qualitative
Numbers	Words
Point of view of researcher	Points of view of participants
Researcher distant	Researcher close
Theory testing	Theory emergent
Static	Process
Structured	Unstructured
Generalization	Contextual understanding
Hard, reliable data	Rich, deep data
Macro	Micro
Behaviour	Meaning
Artificial settings	Natural settings

4.5.3 Triangulation (mixed) method

Despite the increase in the individual application of quantitative or qualitative social research methods to enhance the potential for the improved comprehension of social concepts, there is an increasing tendency for researchers to move towards employing both qualitative and quantitative methods in the same study (Lewis, 2015). Creswell and Clark (2017) believed that this shift results from the categorisation of numerical research as quantitative, with the remainder being qualitative. They argued that any study entailing quantitative and other data types will lead to the inception of mixed methods as a new paradigm for inquiries. Similarly, Saunders (2015) claimed that the ambition of social researchers to conduct more robust research has led to the broad utilisation of mixed methods as a recognised methodology. Similarly, Creswell and David (2017) posited that the mixed method emerged as it enables the clearer visualisation of complexities and social relations through the combination of methods and the recognition of each method's limitations. Nevertheless, some claim that mixed methods' popularity has been driven by the notion of triangulation in social research, which enhances the research findings' validity by mitigating the underlying bias linked to individual methods and the potential for arriving at inappropriate generalisations. Moreover, triangulation offers the potential for presenting multiple findings regarding the same phenomenon by deploying a range of qualitative and quantitative methods in one study (Bryman, 2016).

4.5.4 Justification for the research choice

The mono (quantitative) method will be adopted in this study (see Figure 4.5), where only one data collection technique and its respective analysis procedure will be applied. Saunders (2015) reported that the use of the mono strategy allows individual quantitative instruments such as the survey to be paired with procedures for analysing quantitative data, thus enhancing the confidence of the researcher to explore a phenomenon from different dimensions or perspectives.

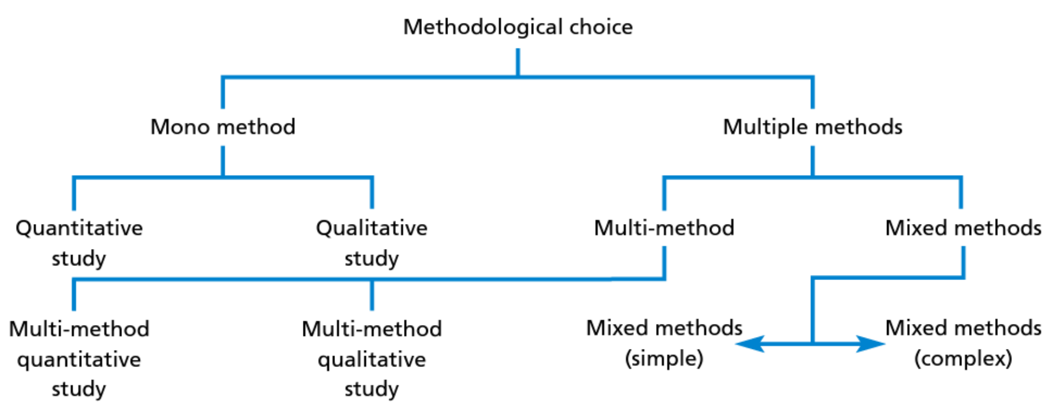

Figure 4.5: The methodological choice (Saunders, 2015)

Evaluating and exploring the research phenomenon through the adopted mono-method will assist in determining the critical success factors for the effective implementation of the ISO 9001 QMS in UK construction projects. Therefore, to understand the actual situation of the phenomenon, a single strategy is adequate, and using one single technique is selected. It is believed that through an in-depth questionnaire survey of project managers in UK construction projects, a better understanding of the phenomenon will be realised. Moreover, a single approach (quantitative) is used in this research because it is part of a deductive approach already in operation in this study, whereby a questionnaire survey of project managers will offer hard data on the topic of interest. The quantitative method, which is broad and in-depth, will therefore be sufficient to understand the phenomenon, and a mixed-method is not required.

4.6 Research strategy

The research strategy is located within the next strata of the research onion. Businesses and management employ a range of strategies to facilitate the gathering of primary data that can be investigated by the researcher. Indeed, the research aim and questions, the availability of time, existing understanding and other available resources, alongside the philosophical foundations, are the representative bases for the selection of an appropriate research strategy (Saunders, 2015). The research strategy depends upon the research approach. A range of appropriate strategies are associated with the qualitative approach, inclusive of action research and the case study (Saunders, 2015); while the quantitative approach includes experiments and surveys as research tools (Creswell, 2014). In his classification of the research strategy, Yin (2014) opted to exclude any reference to action research and ethnography. Importantly, when the researcher selects a research strategy it should fall within three research purposes: descriptive, explanatory, or exploratory. Conversely, the research issue should remain of primary importance so that the researcher selects an appropriate approach that will facilitate a response to the research question(s), together with the achievement of the study's objectives (Saunders, 2015). In the view of Yin (2014), case study design can be categorised into single and multiple holistic case studies, and single and multiple embedded case studies.

Saunders (2015) listed the following strategies for research: action, archival, case study, ethnography, experiment, grounded theory, and survey. It must be noted that despite researchers in particular cases associating certain research strategies with philosophies, differentiating between them can be challenging; for example, ethnography has an association with both interpretivism and realism. On the other hand, despite the surveys being research strategies typically linked to positivism, researchers from the pragmatist and realist domains also utilise them. Further detailed explanation of strategies potentially suited to this study (i.e. survey, grounded theory, ethnographic research, archival research and case study) can be found in the sub-sections that follow.

4.6.1 Survey

Creswell (2014) reported that the survey represents a strategy that enables the generalisation of outcomes through data collected from a sampled population. The survey is an inquiry that is not experimental and can be found in natural systems (Wang, 2015), where the strategy consists of completing a questionnaire or structured interview, with the resulting data then utilised to identify relationships between variables (Fellows, 2015). When employing a survey, the discovery of certain patterns is sought that can be generalised to the whole population (Saunders, 2015). Quantitative data and analysis methods are essential when seeking responses to research questions through this strategy, and therefore the survey is appropriate for paradigms that are positivist in nature (Ary et al., 2018). An essential component of survey research is sampling, where the techniques can be organised into probabilistic sampling (clustered, randomised, stratified, and systematic) or non-probabilistic sampling (convenience, purposive, self-selected, and snowball) (Bryman, 2016). Saunders et al. (2016), reported that questionnaires are one of the most widely employed techniques for data collection in the survey context, since every respondent must answer an identical set of questions, thus providing a highly efficient method of gathering data from a large sample. Nevertheless, they underscored the importance of ensuring that the instrument collects the precise data necessary to answer the research question(s) and fulfil the objectives of the study. Moreover, surveys can produce misleading findings, despite their popularity and broad use, and therefore great care is necessary in their design, distribution and the analysis of the data produced (Neuman, 2014). Ultimately, when conducted with care and accuracy, surveys offer a good solution to the collection of data regarding the behaviours and opinions of a large number of respondents (Easterby-Smith et al., 2015).

The survey was selected for the current research due to its appropriacy in illuminating the critical success factors for effective implementation of the ISO 9001 QMS in UK construction projects from a statistical perspective. It will facilitate in reaching a large number of participants in a cost-effective manner, and will generate quantitative data through which to analyse the study variables. Moreover, due to the volume of data collected and analysed, the approach will help in terms of the generalisability of the research findings.

4.6.2 Grounded theory

Grounded theory entails the progression of theory via the utilisation of qualitative data (Bryman, 2016), and is used to identify theoretical reasons for social processes and interactions in the fields of management and business (Saunders et al., 2016). Since the primary theme is developing theory through data, data collection and analysis occur simultaneously (Fellows, 2015). Oktay (2012) asserted that in order to perfect the theory, the data are continually gathered and dispersed until saturation has been reached, that is, no further themes arise. Saunders (2015) reported a key criticism of grounded theory as its failure to realise the embedded position of the researcher, consequently overlooking his or her significant role in terms of constructing and interpreting the data. Moreover, there is a tendency for grounded theory strategies to generate significant volumes of data that can become unwieldly. Furthermore, grounded theory does not commence with hypotheses or research questions that imply prior assumptions, since the intention is to explore new theoretical stances or knowledge (Gray, 2014).

Grounded theory was thus not chosen due to the lens of focus, where the theory is well developed in the literature. Rather, this study aims to investigate the critical success factors for effective ISO 9001 QMS implementation in UK construction projects through the perceptions of UK construction project managers, with the literature and research question fundamental to this study.

4.6.3 Ethnographic research

For a particular period of time, the researcher is embedded in the social lives of the participants under examination in ethnographic research, with conclusions drawn from the participant observations (Fellows, 2015). The researchers should immerse themselves in the setting and become a part of the group under observation in order to fully comprehend and attach meaning to the behaviours that manifest (Easterby-Smith et al., 2015). Ethnographic research typically requires extensive periods of time in the field and employs the methods of interviews and observation to gather detailed data, while the observation of participants may comprise a considerable component of the fieldwork (Yin, 2018). Ethnographic research is qualitative in nature, with a tendency to include strategies such as correspondence, informal interviews, and observation (Lewis, 2015). It should be noted that ethnography has been described as an instrument for the gathering of data as opposed to a research design (Saunders, 2015). Ethnographic research thus shares similarities with grounded research in that the development of theory and data collection occur simultaneously during the progression of the research (Gray, 2014). However, in many organisations it can prove challenging to gain full access to conduct ethnographic research due to the restrictions that are imposed (Easterby-Smith et al., 2015), for example to protect a competitive advantage.

As this study does not seek to explore the participants' patterns of behaviour or physiology, the researcher does not have the time available to immerse himself in a setting due to the time constraints present in PhD research, and with the literature and research question forming a strong foundation for the study, the ethnographical approach was deemed inappropriate for this research.

4.6.4 Archival research

Researching archives involves the researcher employing data gathered from archival records (Timothy, 2012), since gathering primary data during the research is not always possible or necessary (Easterby-Smith et al., 2015). Saunders (2015) underscored the unobtrusive nature of archival research, since the researcher does not physically engage in the observation of the events or interactions being studied. Moreover, in the current era of digitalisation and the popularity of online archives, sources from around the world can be conveniently accessed, including communications between individuals, diaries, press releases, government publications and media sources, amongst others (Saunders et al., 2016). One example of archival research is exploring national data such as that resulting from census data, while an organisation's annual reports are another popular source of archival data where the researcher can appraise the achievements of the company and review the changes in the language used over time (Easterby-Smith et al., 2015). Researching archives supports those hypotheses where allocating participants into groups is not ethically possible, while it can facilitate in exploring trends found amongst a population. Nevertheless, Ventresca and Mohr (2017) viewed the researcher being unable to control how the data was gathered or to know the controls that were implemented as being a weakness of archival research. Furthermore, Saunders et al. (2015) cautioned that archival research needs to first be established as the optimum approach to gather data to answer the research question, while the ability to access a suitable volume of archives to carry out the research needs to be assured prior to commencement.

Archival research was thus rejected for use in this study, as identifying the critical success factors for effective implementation of the ISO 9001 QMS in UK construction projects needs to be carried out through the perceptions of project managers engaged in the field of interest, which would not be possible through analysis of their organisation's archives. Moreover, since these will be private companies, gaining sufficient levels of access could also prove problematic.

4.6.5 Case study

The case study has been defined as an inquiry that is empirical in nature and conducts an in-depth exploration of a current phenomenon in its actual context, especially when the boundaries between the phenomenon and context are poorly defined (Yin, 2018). The case can comprise one individual, a topic, a group, or an organisation (Lewis, 2015), while the research may include the investigation of one or a number of cases, which can be categorised as follows: (i) descriptive case study, which investigates a phenomenon or process; (ii) explanatory case study, which tends to be driven by theory and may facilitate in developing a hypothesis in studies that are large in size (Fellows, 2015); and (iii) exploratory case study, which is typically utilised for hypothesis testing to produce logical conclusions (Bryman, 2016). Beyond the philosophical perspective, a study's research questions influence which research approach is selected, with Yin (2018) arguing that questions focusing on 'how' and 'why' are preferred in studies of an explanatory nature, while exploratory research relies more on 'what' questions. Consequently, the case study can offer greater insight into research through the exploration and subsequent explanation of the target phenomenon. Fellows (2015) proposed a number of motivations to conduct a case study, including clarifying the linkages amongst cause and effect, alongside describing authentic contexts. According to Saunders (2015), case studies may be grounded in a mono or multi-method choice. Case study research has the ability to employ a range of resources including archival records, documentation, ethnography, focus groups, interviews, various observational mediums, reflection, research diaries, and surveys.

Since this study aims to gain insight into the phenomenon of ISO 9001 in the UK context, and to explore critical success factors that support its effective implementation, the investigation of a larger population of project managers from a larger sample frame of UK-based construction organisations was deemed preferable to the focus on one particular case, since the intention is for the findings to be generalisable to the whole population of ISO-9001 certified construction companies in the UK, while the phenomenon of quality management through the ISO 9001 QMS is clearly defined..

4.6.6 Justification for the survey as the primary research strategy

The survey method is adopted in this study because the survey approach is regularly linked to the deductive approach. Moreover, online surveys are popular because they allow for a considerable volume of data to be collected from a large population with a low likelihood of distortion in the respondents' responses, limited cost implications for the researcher (i.e. the fee to establish the online survey), and the method is well suited to closed questions (Saunders et al., 2016). Neuman (2014) asserted that surveys are appropriate when the aim to understand more about the respondents' behaviours or self-beliefs by gathering descriptive data to measure many variables, which is applicable in this study given the large number of critical success factors and factor components to be investigated. Moreover, online surveys through tools such as SurveyMonkey make the survey instrument more attractive to complete, allow sections be included or omitted based on conditional logic, and provide data that can be directly downloaded to the Statistical Package for the Social Sciences (SPSS) or Excel, thus offering excellent efficiency savings for individual researchers (Saunders et al., 2016). This method also offers an opportunity to explore key topics with a large number of project managers, as well as being an appropriate mechanism for gathering perceptions regarding the ISO 9001 QMS that will facilitate in the identification of critical success factors for its effective implementation in UK construction projects. The instrument (questionnaire) was developed by utilising relevant communication tools, using closed and open questions. Saunders (2015) asserted that the survey approach is regularly linked to the deductive approach and reflects a commonly deployed method in business research and administration that is habitually harnessed to answer 'who, 'what', 'where' and 'how' questions, and thus has a tendency to be utilised as an instrument of exploratory research and description. However, caution should be applied when considering surveys to answer 'why' questions, which are more suited to other approaches such as interviews or observations (Neuman, 2014). Due to the standardised nature of the data collected from surveys, comparison is possible. Moreover, surveys offer a cost-effective means of gathering a volume of data from a large sample of geographically dispersed respondents with no fieldwork required by the researcher (Saunders et al., 2016). Therefore, the survey strategy is viewed as being well suited to this study, resulting in data that can be easily interpreted and understood, provided that the design, deployment and analysis are conducted with great care and precision.

4.7 Time horizon

A fundamental component of Saunders's (2015) research onion is the time horizon, with Saunders (2015) demonstrating that all researchers employ the time horizon as a time framework when conducting research. He classified the time horizon into cross-sectional and longitudinal domains (Saunders, 2015), where the former means that the study is limited to studying a particular phenomenon in a particular time period, which is exploited to complete the research study (Luo and Flick, 2012), while longitudinal studies concentrate on examining a specific phenomenon and controlling for the changes and development over a longer time period, and whilst these studies provide a clearer picture of reality, they require more time to complete (Saunders, 2015).

As this study does not aim to test the development and changes of a specific phenomenon over time, and since the research in this study is confined within the requirements of a PhD programme, a specific time period is important to ensure a successful outcome. Therefore, by concentrating on a particular time period, the cross-sectional time horizon will be more suitable for this study.

4.8 Research techniques

Saunders (2015) distinguished collecting and analysing data as the key component of research, where he underscored several essential issues relating to data collection and validation: sampling, primary data and secondary data. Three techniques have been selected for this research: (i) a literature review explores secondary data; (ii) an online questionnaire collects primary data to identify the critical success factors for successful ISO 9001 implementation; and (iii) semi-structured interviews will allow the critical success factors to be validated. These techniques are discussed in a greater depth below in the present study's context.

4.8.1 Literature review

The literature review describes and critically analyses the current state of knowledge in terms of the subject focus (Saunders, 2015). Moreover, any subsequent research is supported through critiques of that which has previously been conducted, with the review of the literature explaining the importance of the research (Creswell, 2014).

In this research, the literature review features two stages:

- Early in the research, an initial literature review was conducted to acquire awareness of the contemporary challenges facing construction projects (particularly in the UK) and those challenges facing effective implementation of the ISO 9001 QMS in construction projects, thus highlighting the research problem and leading to the formation of the research question and the aim and objectives of the study.
- With the research question, aim and objectives established, an in-depth literature review was carried out to develop knowledge on the themes of UK construction, quality, quality management, the ISO 9001 QMS, and its effective implementation in construction projects, with the lens of focus placed on the fundamental and theoretical conceptions. It was employed to develop hypotheses as secondary data to support the identification of critical success factors for effective implementation of the ISO 9001 QMS in UK construction projects.

4.8.2 Questionnaires

Questionnaires are widely employed techniques for the gathering of survey data that are often numerical and tend to be easy to examine (Saris and Gallhofer, 2014). Despite being frequently viewed as an easy option, the use of questionnaires actually requires careful planning and design, while analysing the generated data requires a statistical approach. The creation, administering, data processing, and analysis, along with the factor analysis technique, all need to be given due consideration (Saunders, 2015). Saris and Gallhofer (2014) asserted that questionnaires offer researchers the opportunity to collect data about the participants' attitudes, behaviour, and knowledge that is objective in nature. Testing the instrument is vital to its success and often comprises two stages: testing the questions, and then the questionnaire. However, Creswell (2014) reported that the majority of questionnaires will be conducted in a single phase. Regarding the size of the sample, the acceptable accuracy must be considered, while a sampling frame must also be established, namely, a list of cases representative of the respondents (Rowley, 2014). Brace (2018) reported that a questionnaire can be categorised as (i) structured, which features closed questions supporting the data analysis through the generation of frequencies of response; (ii) semi-structured, which includes open-ended questions designed in terms of their sequence and structure to enable the participants to focus their responses in their own words; and (iii) unstructured, which features open-ended questions, where the participants can reply freely with minimal structuring.

In this research, a structured questionnaire was employed to gather information regarding the critical success factors for effective implementation of the ISO 9001 QMS in UK construction projects. The target participants were project managers from UK construction companies engaged as contractors, where the companies were both ISO 9001 certified *and* implemented the quality system in their projects. The questionnaire approach enables highly specific data to be gathered from a significant number of participants. The questions in the instrument were structured in order to allow both nominal and ordinal measurement. It must be underscored that the choice and degree of measurement impact the data analysis type to be carried out, with bar charts, cross tabulation, and frequency distribution employed to display the results of the survey. The questionnaire in this study comprises of two parts: (i) the background of the respondent's organisation regarding the application of ISO 9001; and (ii) questions designed to identify and evaluate the critical success factors for effective implementation of the ISO 9001 QMS in UK construction projects. All determinations and evaluations were expected to contribute towards the identification of critical success factors for the phenomenon of interest, with the study focusing on construction projects managed by construction companies as a contractor, where those project managers who managed construction projects were invited to participate in the research as a representative of their construction companies.

4.8.3 Interviews

The choice of interviews is driven by the degree of value to be realised by collecting the data (Yin, 2018), which is pertinent as evidence sources that include company or personal records are often confidential, where accessing such documentation and views may be beyond the researcher's control. Van Teijlingen (2014) described interviews as a transparent exchange that can be face to face, or via technology such as applications like Skype or the telephone. While the strength of the interview is its ability to produce information swiftly and in considerable volume, there are also limitations such as the interviewee being uncomfortable or unwilling to share their perceptions/ experiences on all aspects that are intended to be explored (Bryman, 2016). Easterby-Smith et al. (2015) presented the structured, semi-structured and unstructured interviews as the three main types, whereby structured interviews involve a pre-determined list of questions, where each may have specific categories of response; semi-structured interviews allow questions to be asked in a more flexible manner; and unstructured interviews are where questions are posed to commence a conversation as opposed to acquiring a response. Yin (2016) described the most important component of the qualitative interview to be open-ended questions, whereby the participants respond in their own words, while close-ended questions tend to allow only a certain number of predefined responses. Furthermore, the questions in structured interviews are determined prior to the interview itself with specific wording and a strict structure, while in semi-structured interviews additional questions may be asked, and unstructured interviews are very informal and develop through the conversations that unfold (Robson and McCartan, 2016).

In this research, interviews of a semi-structured nature were carried out to allow validation of the questionnaire results and acquire a deeper understanding of the current status of the ISO 9001 QMS's implementation in UK construction projects. Again, the target participants for the interviews were project managers from UK-based construction companies engaged as contractors, where the companies were both ISO 9001 certified *and* implemented the quality system in their projects. More details about the critical success factors were also gathered in terms of the ISO 9001's effective implementation in UK construction projects. The interviews would assist the researcher in understanding the current advantages of ISO awareness among construction organisations, thus rendering semi-structured interviews a suitable data-collection approach. Furthermore, Bryman (2016) confirmed that when the theme being studied is familiar to the researcher and the focus is placed on a specific area, interviews are an ideal technique for the collection of data.

4.8.4 Data sampling

Regardless of the research objectives, the researcher must consider whether sampling is required (Saunders, 2015). Choosing the sample is equally important, irrespective of the researcher's intention to employ a questionnaire, interviews, observations, or another technique for data collection purposes (Saunders, 2015). Sampling is a process whereby parts of an entire population are selected to participate in the gathering-of-data phase (Bryman, 2016). Saunders et al. (2016) described the sampling fame as the full population from which the sample will be drawn, while cautioning that the absence of a sampling frame means that a probability sample cannot be selected. Robson and McCartan (2016) described the sample frame as the population from which the sample will be taken, suggesting that for a survey of individuals within an organisation, this could comprise all those on the payroll, with there being clear benefits to being able to identify a complete list of all those who comprise the full population. In this study, the population of interest was project managers engaged with UK-based ISO 9001-certified construction companies. From a 2018 global survey conducted by ISO (2019), it was found that there were 878,564 ISO 9001-certified organisations worldwide, of which construction organisations comprised 75,080 or 8.55% of this global population. From the same survey, it was reported that the UK had 26,435 ISO 9001-certified organisations in 2018. Therefore, by applying the same (global organisations : construction companies) ratio to the UK content, the number of UK-based ISO 9001-certified organisations in 2018 was approximated at 2,260 firms, which was considered the sampling fame in this study. With the sampling frame established, it was then necessary to determine how valid responses could be gathered (Easterby-Smith et al., 2015).

In terms of the participants' demographics, no such data was collected from the questionnaire survey participants, while some information (e.g. gender, experience, and project type) did emerge from the interviewees due to the qualitative nature of the validation interviews. The collection of such data was not overlooked, but rather the emphasis on this study was placed on ISO certification as the main criterion of interest. In terms of the EU's General Data Protection Regulation (GDPR) and the UK's 2018 Data Protection Act, which concern the processing of personal data within the UK, in the case of academic research the issues surrounds the collection of personal data through which the participants, either directly or indirectly, can be identified (UK Research and Innovation, n.d.). While GDPR features the ability for Member States to issue exemptions in order to enable academic expression, Mourby et al. (2019) reported that in practice researchers will not receive greater freedom in terms of processing data under GDPR. In this study, it is believed that no personal identifiable information is revealed (e.g. personal names, company names, site addresses); all the gathered data (i.e. the questionnaire responses and interview recordings/transcripts) have been stored securely on the researcher's computer, and will be destroyed on the completion of this PhD study.

Two sampling techniques (probability and non-probability sampling) exist when conducting research, and in this study both probability and non-probability sampling were used, as described below

4.8.4.1 Probability sampling

The population units are chosen with a certain degree of randomness (Etikan et al., 2016) in probability sampling. The likelihood of choosing any component of the population is highest when this technique is employed (Saunders, 2015). Saunders (2015) underscored that probability sampling approaches are widely used in research strategies that are based on surveys when statistical significance is required for the data analysis, and thus the results can be deemed representative of the whole population.

According to Saunders (2015), selecting a research sample involves four primary techniques: (i) simple random sampling, described as a statistical population's sub-set, whereby every member has the same chance of being selected; (ii) systematic sampling, defined as a probability sampling type whereby a broader population's members are chosen based on a starting point that is random and a defined interval, with the latter representing the size of the population divided by the sample's required size; (iii) stratified (probability) sampling, whereby the whole population is categorised into sub-groups, with the ultimate subjects randomly selected from the different sub-groups in a proportional manner; and (iv) cluster sampling, which is a technique employed when a statistical population has natural although comparatively heterogeneous groupings.

In this study, where a questionnaire is employed, probability sampling was used, which is commonly associated with survey research where the intention is to draw inferences from the sample to respond to the research question and objectives in terms of the population as a whole

(Saunders et al., 2016). The sampling properties and the probability sampling procedure can be described as follows: (i) detect an appropriate sampling focus that reflects the research objectives, namely project managers from the approximately 2,260 ISO 9001-certifed UK construction companies; (ii) adopt a suitable sample size; and (iii) identify the most appropriate technique for selecting the sample. In terms of the sample size, Easterby-Smith et al. (2015) applied the analogy of the sample frame as the pot of soup, and the sample size being the spoon used to sample that soup sufficiently to be able to form judgements of the soup as a whole (i.e. generalisation). Saunders et al. (2016) claimed that for research embarking on statistical analyses, a minimum sample size of 30 is required. In terms of the sample size in the current study, this was calculated using the equation provided by Easterby-Smith et al. (2002) for determining the minimum sample size (n) based on the maximum permitted error (E) as follows:

$$n = \frac{2,260}{E^2}$$

With a standard error of 5%, the minimum sample size was calculated as 91 responses. However, as a 100% response rate is unrealistic (Saunders et al., 2016), a larger sample was required to ensure that sufficient responses would be received. Neuman (2014) suggested response rates for postal questionnaires of 10–50%, while Saunders et al. (2016) reported response rates to online business questionnaires of 10–20%, citing respondent fatigue as a major factor contributing to the low response. Construction companies were randomly selected from a number of databases (i.e. APC Services Ltd, Builders UK Ltd, Kompass UK Ltd, UK Business Databases Club, listofbuilders.co.uk) using the systematic sampling technique described by Bryman (2012), where units can be selected from the sampling frame without the need to engage with a table of random numbers.

A total of 1,000 emails were sent that included a link to the quality management survey and a covering letter (see Appendix 2) explaining the study's aim, how the survey data would be utilised, and guidance on how to complete. Moreover, the participants' confidentiality was assured. To increase the response rate, a follow-up reminder was sent out after the second week, permitting a further week for respondents to complete. It should be noted that there appeared to be a certain number of 'bounced emails' as the recipients were no longer employed by the company the email address was associated with. The survey was commenced in the UK in the first week of April 2019 using the Survey Monkey online survey tool, and remained open for 2 weeks. A total of 124 questionnaires were completed and returned, representing a response rate of 12.4%, and thus the final sample fraction, calculated by $\frac{n}{N}$ (Neuman, 2012) was found to be 5.6% of the whole population. Furthermore, the minimum sample size of 91 responses was both fulfilled and extended.

4.8.4.2 Non-probability sampling

Bryman (2012) described non-probability sampling as a term utilised to capture all those sampling forms that fall outside the realms of probability sampling. Non-probability sampling offers a number of alternative sample-selection techniques that involve subjective judgement to a certain extent (Saunders et al., 2016). Saunders (2015) asserted that when a different type of sample selection is necessary due to the research aim and objectives, then non-probability sampling techniques are utilised, with four primary sample selection methods: (i) purposive sampling, which is used in cases where the sample is chosen for a specific purpose; (ii) convenience sampling, with the sample identified from easily accessible members of the population; (iii) volunteer sampling, containing the two primary groups of snowball sampling (e.g. referrals) and self-selection; and (iv) quota sampling, where the sample is categorised into groups on the basis of certain characteristics such as gender. Neuman (2014) asserted that non-probability convenience sampling is applicable where the primary case-selection criteria are that participants are easily accessible, available or convenient, while Bryman (2012) underscored that the investigation of organisations and social studies are frequently conducted using convenience sampling. Saunders et al. (2016) suggested a minimum sample size of 5–25 participants for semi-structured interviews, and in this study given the validation purpose of these interviews, six participants were deemed sufficient to achieve this objective. Therefore, in this study, convenience sampling was utilised to identify and invite six project managers to participate in the validation interviews.

4.8.5 Data analysis

Data analysis represents a significant component of any research since it facilitates in investigating the gathered data in order to draw conclusions (Creswell and David, 2017). Lewis (2015) asserted that the analysis of the data begins with its separation into its smallest parts. Next, these are organised by the researcher who seeks to identify patterns, sequences, or types, where qualitative and quantitative data are even combined in the search for evidence to respond to the original study aim (Yin, 2017). The intention of the procedure is to meaningfully gather or rebuild the data (Heeringa et al., 2017), with Glesne (2015) reporting that data analysis assists in generating theory that is supported by evidence of an empirical nature.

As aforementioned, in this research quantitative data collected from a questionnaire was selected for the investigation stage as the main method to facilitate in determining the critical success factors for effective implementation of the ISO 9001 QMS in UK construction projects, while qualitative data from semi-structured interviews was selected for the validation stage to enable the findings from the questionnaire survey to be validated.

4.8.5.1 Quantitative data analysis

The analysis of quantitative data frequently addresses data analysis approaches of a statistical nature, and commonly includes chi-square, correlation, and factor analysis, among others (Ott and Longnecker, 2015). Plans to analyse quantitative data tend to comprise the assessment of raw data, the entry, transfer and processing of data, completing the analysis, interpreting the findings, and then communicating them (Treiman, 2014). Saunders (2015) recommended analysing quantitative data collected from surveys via (i) descriptive statistics that are employed to depict the core nature of the data, while defining its deviation (Hinton et al., 2014), where the core nature represents those values with the potential to provide a broad perspective of the data (Saunders, 2015); or (ii) inferential statistics that are used to explore differences, relationships, and trends within the quantitative data and enable its testing for the significance and strength of the variables' relationships (Saunders, 2015). Furthermore, the measurement degree can impact the analysis type employed through nominal, ordinal, interval, and ratio measurement (Walliman, 2017).

In this study, the quantitative analysis is targeted towards identifying the critical success factors for effective implementation of the ISO 9001 QMS in UK construction projects, to be constructed from the literature review and the quantitative analysis results emerging the questionnaire data. Therefore, to interpret the questionnaire survey results, descriptive and inferential statistics were applied as descriptive analysis to enable specific data sets to be summarised in the context of the deviations (i.e. average, mean, median, and standard) that represent a sample of the overall population, while the inferential analysis allowed the measurement of the strengths of the links amongst two variables, achievable via the correlation approach. The SPSS (v.24) quantitative software programme was utilised to facilitate the coding and analysis of the data.

4.8.6 Validity and reliability

In terms of assessing how robust a research answer may be, Heale and Twycross (2015) suggested evaluating the validity. There are two validity domains: internal validity determines whether the identified cause actually produces the phenomenon and verifies that the accuracy of the established cause and effect relationships is correct; while external validity indicates the extent that a finding is generalisable to the wider population (Yin, 2018). It should be underscored in the context of quantitative and qualitative research that differing views on validity can be found, where several strategies to assure research validity were recommended by Saunders (2015), including triangulation that enhances the consistency of the data through its collection from more than one source. Three measures to assure the reliability of research were advocated by Saini and Shlonsky (2012): the supporting of themes by including quotations and examples, ensuring that the quotations and themes are consistent, and ensuring that the research process is transparent. Rajasekar et al. (2013) reported that the aim of reliability is to reduce the research errors and bias to a minimum, where the objective is to assure that were another researcher to follow the process precisely, identical conclusions and findings would be realised.

In this research, the literature review and the questionnaire survey of project managers were employed to provide multiple data sources to facilitate the identification of the critical success factors for effective implementation of the ISO 9001 QMS in UK construction projects. In the mono-method of research, these forms of data are all deemed to be acceptable, and therefore the accuracy of the current research will be increased. In terms of consistency, the confirmation will be from the literature review and the provisional critical success factors' ability to reflect the responses of those questions directed to the project managers of UK construction companies, as gathered from the questionnaire survey. Then, conducting interviews of a semi-structured nature in the qualitative phase of the current research will enable the results from the questionnaire survey data to be validated and refined in the qualitative stage.

4.9 Conclusion

This chapter considered the philosophy of the research; the approach, strategy, and choice; the techniques applied to collect the data; and the testing and validation. Positivism was selected as the research philosophy that forms the foundation of this research, as it seeks to employ theory in order to investigate the research phenomenon in a highly structured and replicable manner. The deductive approach was selected to enable the critical success factors to be developed based on the literature, followed by testing of the interpretation of the causal relationships that may exist, and the measurement of quantitative concepts. This approach will allow to enable the findings to be generalised to the wider field of ISO 9001 implementation in UK construction projects. It was decided to adopt a single approach (quantitative) methodology for this research. Three techniques were selected: (i) a literature review to explore the secondary data, (ii) an online survey to collect primary data on the critical success factors identified in the literature, and (iii) semi-structured interviews to enable the data collected through the survey to be validated. The sampling frame was established, and the approach to determine the minimum sample size (n=91) was presented. Then, the probability sampling approach was determined for the selection of the participants for the survey, to provide primarily quantitative data through their responses, while convenience sampling was selected to recruit the participants for the interviews, with qualitative data collected for the validation. It was intended that the adopted methods would assure that the research process would be both valid and reliable. The next chapter presents the investigation stage, where the provisional critical success factors that emerged from the literature review were tested through the deployment of a questionnaire survey to explore the perceptions of project managers engaged in the field on UK construction projects.

Chapter 5

The ISO 9001 Quality Management Survey

5.1 Introduction

In the previous methodology chapter, this study's research design and the methodology were described in detail and discussed. In this chapter, the measures adopted in order develop the ISO 9001 quality management survey are first discussed, including the questionnaire design, ethical issues that arise, piloting the instrument and the conducting of a reliability test. Then, the survey data is presented and analysed in terms of the respondents' responses ranked by the extent to which the participants agreed or disagreed with the importance of the critical success factor components presented. These results are discussed in comparison with the literature, while additional qualitative components added by the participants are presented and considered in terms of their frequency of mention. After the results for all ten critical success factors that emerged from the literature review have been presented, the results are passed through a series of statistical tests, namely the compare means, Kendall's W, Kruskal Wallis, and Spearman correlation coefficient tests. Finally, the findings from the questionnaire survey are presented in terms of the critical success factors and factor components deemed vital to ensure the effective implementation of the ISO 9001 QMS in UK construction projects to ensure successful outcomes, as perceived by the participant projects managers who responded to the questionnaire survey.

5.2 Questionnaire design

The intention of designing a questionnaire is to convert the research objectives into associated questions; the responses to which should produce data to respond to the research question(s) (Brace, 2018). Therefore, the planning of the questionnaire and the subsequent design represent a vital phase in the process of survey development (Robson and McCartan, 2016), with the literature review suggesting that the majority of the issues with questionnaire data originate from the project's implementation phase. The success of a survey relies heavily on the construction of the questionnaire, since questions that are inappropriate or poorly ordered, faulty scaling, or the substandard formatting of the instrument may render the survey of little-to-no value. Moreover, questionnaires that are designed in an unsatisfactory manner can become the primary source of non-sampling issues, while negatively influencing the final rate of response.

The questionnaire in this research was designed to identify the critical success factors expected to support effective implementation of the ISO 9001 QMS in UK construction projects, and was grounded in the ten critical success factors identified following an in-depth review of the published literature in Chapter 3 (see Table 3.4), where the cited studies empirically explored and evaluated quality management in organisations.

The majority of the constructs were operationalised through modification of the validated scales employed in the aforementioned research, which was necessary as it was not always possible to directly utilise the existing instruments. Therefore, based on the literature a number of new items were constructed, representing a strategy that researchers widely utilise when existing instruments are unavailable (Saunders, 2015).

The questionnaire consists of 13 questions and 85 variables or statements (see Appendix 1). The first three questions were intended to determine whether the organisation had a formal ISO 9001 QMS in place, while the remaining ten questions were designed through data extracted from the literature review to assess, identify and include those critical success factors expected to support effective implementation of the ISO 9001 QMS in UK construction projects. The critical success factors and associated components are summarised as follows:

- Change factor (4 components identified)
- Evidence-based decision-making factor (11 components identified)
- Client focus factor (7 components identified)
- Non-standardisation factor (3 components identified)
- Engagement factor (7 components identified)
- Leadership factor (12 components identified)
- Process approach factor (11 components identified)
- Management of relationships factor (9 components identified)
- Skills and training factor (7 components identified)
- Continuous improvement factor (11 components identified)

5.2.1 Questionnaire rating scale

Following the review of a range of rating scales (ordinal and interval scales), an approach was selected that the researcher believed would result in an easy-to-complete questionnaire, and which would therefore encourage participation. The most suitable scale to collect the required data was found to be the 5-point Likert scale, as this is both familiar and easy to answer (Robson and McCartan, 2016), while this scale would be appropriate to the respondents' experience and knowledge. This measure uses a 5-point scale that is grounded in familiar, commonly used notions. It was utilised by Leong Tiong et al. (2014) in their study investigating the implementation of QMSs in the Malaysian construction industry and has been demonstrated as a tool that is both reliable and enables a satisfactory level of comparison. With the rating scale being easily understood and requiring no explanation, the 5-point Likert scale offers both clarity and comprehensibility, especially across languages and cultures. The scale is suitable for correlation or regression due to the granularity, sensitivity and discrimination, where 5-point scales offer improved correlation, central tendency, and dispersion analysis than those scales featuring fewer values.

Subong (2005) reported that in the interval variable 5-point Likert scale, the interval measurement is expressed in numbers, where meaningful information is conveyed with respect to the distance or degree of difference (see Table 5.1).

Table 5.1: The 5-point Likert scale's intervals of level (Subong, 2005)

Scale	Description	Average
1.0 – 1.80	Strongly disagree	Low level
1.81 – 2.60	Disagree	
2.61 – 3.40	Neither agree nor disagree	Moderate level
3.41 – 4.20	Agree	High level
4.21 – 5.00	Strongly agree	

5.3 Ethical issues

It is the ethical obligation of social science researchers to ensure the protection of the participants' welfare (Flinders, 1997), and thus careful consideration was given to the potential impact on them during the respective parts of the survey. Consequently, the researcher addressed the following ethical issues in order to preserve the participants' rights during the study: (i) it was clearly stated to all the respondents that their participation was voluntary, and that they could refuse to respond to any question without repercussion; (ii) the aim and the importance of the study were explained, while the relevance of their responses to acquiring reliable results and thus facilitate the researcher's ability to achieve the research aim was underscored; (iii) the participants were clearly informed that any submitted information would only be utilised for academic purposes within the parameters of this PhD study; (iv) the submitted information (both in electronic and paper form) was collected and stored safely and securely; (v) the participants were assured that the data would be represented sincerely and analysed using the researcher's full ability and experience; and (vi) the participants were informed that the researcher would remain available to respond to any questions or issues that arose during the study. Moreover, ethical approval for this study was received by the University of Salford's Research and Innovation and Academic Engagement Ethical Approval Body (see Appendix 3).

5.4 Questionnaire pilot test

According to Caspar et al. (2016), a pilot test is used to verify the wording of the questions to bring to light issues with the questions (e.g. ambiguity), as well as to gain feedback on the instrument's layout. A pilot test should be conducted prior to conducting the main data collection (Bolarinwa, 2015). In this case, the pilot study comprised of testing the instrument (questionnaire) to confirm that the final version functioned appropriately, whereby any issues emerging during the piloting phase could be resolved prior to it being deployed for the study's primary data collection, while minimising the risk of distributing an instrument featuring questions unsuited to the study, and thus ensuring the most effective use of the researcher in terms of the cost, effort, and time. The pilot was used to verify that the meaning and language used in the questions were suitable, to confirm that the inter-variable relations could be interpreted correctly, and to approximate the time required for the instrument to be completed. The instrument was, therefore, pre-tested with three academics who are personal contacts of the researcher and are actively engaged in research in the construction industry context, as well as his PhD supervisor.

The pilot resulted in the following modifications:

- The elimination of two questions (14 and 15) due to the weakness of their relationship with the aim of the questionnaire.
- The modifying of some questions in the questionnaire to be simpler and easier to understand, especially questions 3–13.
- The deletion of some of the question options, with others adjusted to be easier to understand and support the purpose of the study.

5.5 Reliability test

In addition to the pilot study, a reliability test was undertaken to find the instrument's internal validity and reliability through the use of the SPSS (v.24) software; the sample chosen was from persons known to the researcher who were working in the field of construction: 21 responses were obtained. The questionnaire's coefficient of Cronbach's alpha for internal consistency was found to be 0.845 (Table 5.2), which was reported as being reliable for the collection of data, with Yin (2018) asserting that in general a ≥ 0.70 reliability coefficient is acceptable.

Table 5.2: Reliability statistics

Cronbach's Alpha	N of Items	No. of Participants
.845	85	21

5.6 The results

In total, 124 responses were received and analysed by employing SPSS (v.24), representing a 12.4% response rate. Saunders et al. (2016) reported response rates to be typically within the 10–20% range for online questionnaires, which they partially attributed to 'questionnaire fatigue'.

Moreover, Neuman (2014) suggested that response rates in the 10–50% band could be expected from postal questionnaire surveys, which share many of the characteristics of the online instrument employed in this research. Again, with postal questionnaire surveys used as a comparison, Easterby-Smith et al. (2015) reported that low response rates are typical, with a 20% response rate deemed to be a good outcome. Although the final response rate could be considered low, with 1,000 invitations to participate distributed, the overall response rate of 124 instruments was of a sufficient number to allow the study to progress towards satisfying the research objectives and addressing the research aim, with the minimum sample size of 91 responses both achieved and surpassed (see section 4.8.4.1).

5.6.1 Participants' general information (part one)

In part one of the survey, the participants were asked whether their organisation had gained ISO 9001 certification, in order to determine if their responses could be used for this study. Table 5.3 below shows the number and percentage of ISO 9001-certified companies in the study sample.

Table 5.3: Organisation has ISO 9001 QMS certification

Answer	Frequency	Percent
Yes	117	94.35%
No	7	5.65%
Total	124	100%

Table 5.3 shows that the overwhelming majority of the project managers participating in the quality management survey belonged to ISO 9001-certified organisations. Of the 124 respondents, 117 (94.35%) were from ISO 9001-certified organisations, while 7 (5.65%) respondents reported that they belonged to organisations that did not have ISO certification. Therefore, it is evident that the overwhelming majority of UK construction companies included in the sample believed in the importance of ISO 9001 certification in terms of the management of their organisation, which

reflects an improvement on the results from Marasini and Quinnell's (2010) survey of 35 project managers that revealed a need for awareness raising of the benefits of QMSs.

Figure 5.1 below presents the sample's distribution in terms of the affiliation of the participants to ISO 9001-certified organisations.

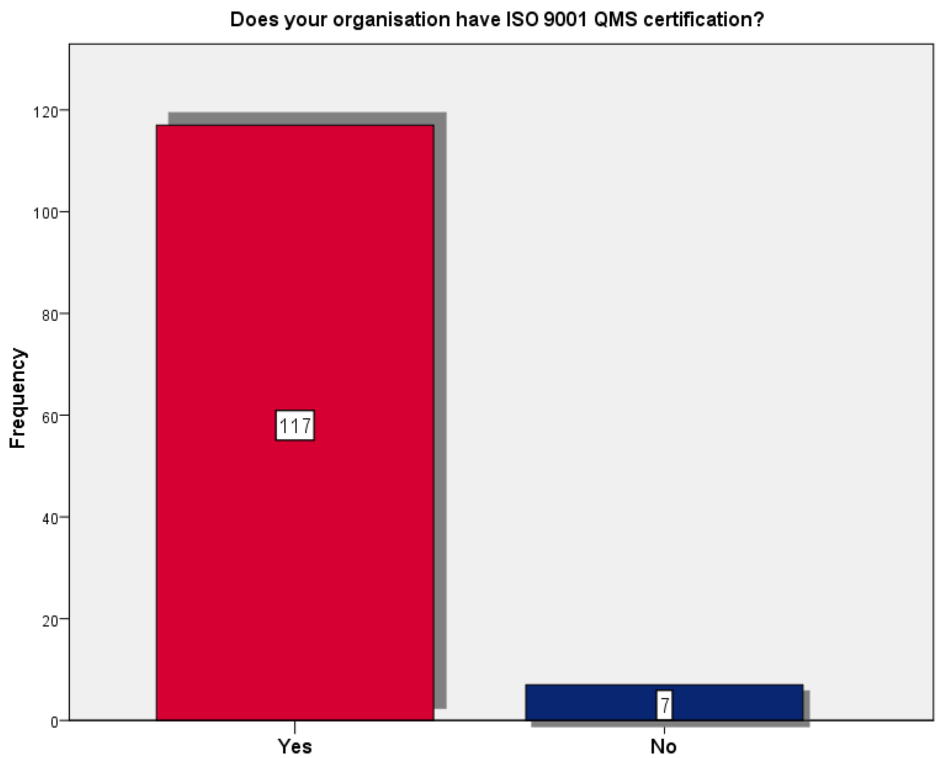

Figure 5.1: Organisational application of ISO 9001 QMS certification

Next, Table 5.4 illustrates the participants' views on the reasons why their companies had not obtained the ISO 9001 certificate, with this option presented in the survey where the participants answered negatively to the previous question on whether their organisation was ISO 9001 certified.

Table 5.4: The respondents' comments on why ISO 9001 certification was not held

Comments	Frequency	Percent
Our company is not large enough to set up the system and maintain it accordingly	1	14.29%
We utilise ISO Health & Safety Standards which align with ISO 9001 standards	1	14.29%
I do not have information	1	14.29%
Hasn't been a critical requirement	1	14.29%
No response	3	42.86%
Total	7	100%

Table 5.4 presents the four comments from the total of seven respondents whose organisations did not have ISO 9001 certification. The comments all differed. One of the respondents stated that their company had an ISO certificate of Health & Safety that conforms to the ISO 9001 standard, while another stated that the size of their company was too small to justify implementing and maintaining the ISO 9001 standard. One of the respondents had no information to offer, while the final one pointed out that acquiring such certification had not been a critical requirement. In other words, for this respondent, his/ her clients may not have required ISO certification to date, while also suggesting limited awareness of the broader importance of applying the ISO standards.

To ensure the effective implementation of ISO standards in those construction projects supervised by the project managers participating in the quality management survey, they were asked whether they applied the ISO 9001 standard in the construction projects they managed, to confirm their ability to complete the quality management survey. Table 5.5 presents the sample distribution based on the application of the ISO 9001 standard in construction projects.

Table 5.5: Application of the ISO 9001 QMS standard in construction projects

Answer	Frequency	Percent
Yes	117	94.35%
No	7	5.65%
Total	124	100%

It can be seen from Table 5.5 that the project managers' affirmative responses are identical to those in Table 5.3, whereby of the 124 participants, 117 (94.35%) confirmed that those organisations that had ISO 9001 certification applied the ISO 9001 standard in their construction projects.

Figure 5.2 presents the distribution of the sample according to their ISO 9001 implementation in the construction projects they manage.

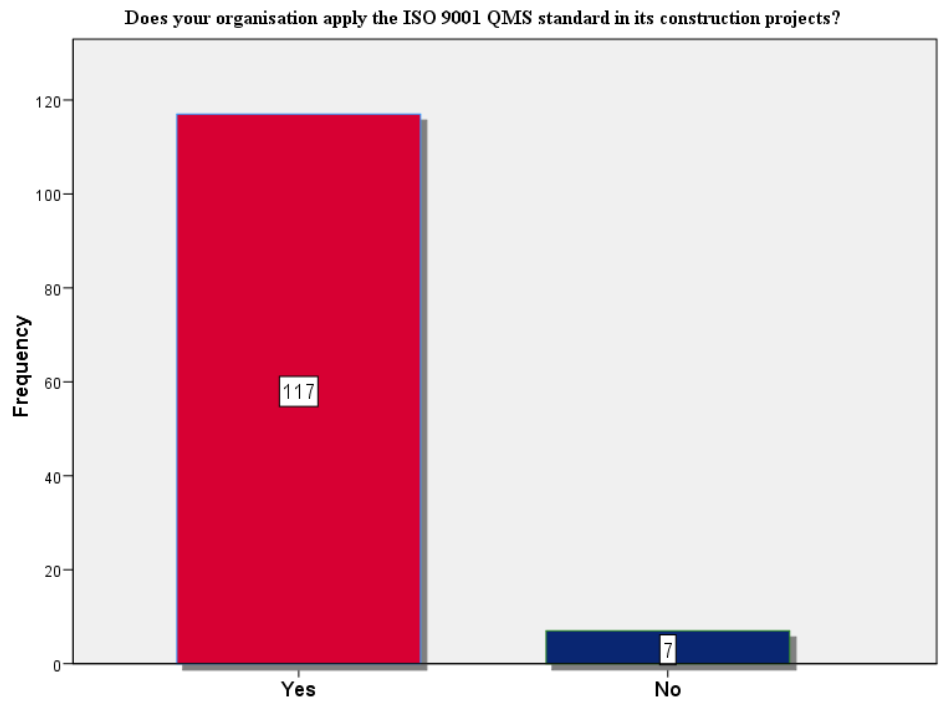

Figure 5.2: Organisational application of the ISO 9001 QMS in UK construction projects

Table 5.6 presents the views of the participants who provided a response as to why they did not apply the ISO 9001 standard in their construction projects, with this option presented in the survey where the participants answered in the negative.

Table 5.6: Why the ISO 9001 standard was not applied in construction projects

Comments	Frequency	Percent
We utilise ISO Health & Safety Standards which align with ISO 9001 standards	1	14.29%
We have not been required by our existing client base to do so	1	14.29%
We do not need that	1	14.29%
No response	4	57.14%
Total	7	100%

Table 5.6 includes four comments from a total of seven respondents who stated that they did not apply the ISO 9001 standard in their construction projects. Again, the comments differed. One of the respondents reported that his company had an ISO certificate of Health & Safety complying with the ISO 9001 standard, while another reported that the clients did not ask the company to apply the ISO standard. The final comment stated that it was not necessary to apply the ISO 9001 standard in the construction projects the company managed, which again indicates insufficient understanding of the importance of its application.

To inquire further about the participants who did not meet the ISO 9001 standard in their projects, or their companies did not have ISO 9001 certification, the participants were asked whether they applied other quality standards in their projects if they did not comply with the ISO 9001 standard. Table 5.7 presents the sample distribution according to the application of other quality standards in their projects.

Table 5.7: An alternative QMS adopted to manage quality

Answer	Frequency	Percent
Yes	4	57.14%
No	3	42.86%
Total	7	100%

Table 5.7 shows that four of the participants who reported that they did not have an ISO 9001 certificate applied other quality standards, while the remaining three (out of the total of seven participants) responded that they did not apply any alterative standard of quality. Table 5.8 shows the views of some of the participants regarding the application of alternative quality standards in their projects.

Table 5.8: Application of alternative quality standards in projects

Comments	Frequency	Percent
We utilise ISO Health & Safety Standards which align with ISO 9001 standards	4	66.67%
Quality system not applicable with us	1	16.67%
I do not have information	1	16.67%
Total	6	100%

Through Table 5.8, it can be seen that four participants stated that they applied the ISO standards of Health & Safety, which complies with the ISO 9001 standard.

Due to the above results and the previous analysis, three of the participants were excluded from the remainder of the quality management survey because their companies did not have ISO 9001 certification in any form, did not apply the standard in their projects, nor did they adhere to any other quality standard as an alternative to ISO 9001.

5.6.2 Breakdown of the critical success factors (part two)

In this section, the data gathered from part two of the survey will be presented, namely the results of the main questions or critical success factors in the quality management survey, to determine the extent that the participants agreed with the literature review results in order to confirm which success factors are considered to be critical to supporting effective implementation of the ISO 9001 QMS in UK construction projects.

The questions in this part comprise of items utilising the 5-point Likert scale, where the range extends from 1 (strongly disagree) to 5 (strongly agree), in an attempt to establish whether the respondents agreed with the research hypotheses. To interpret this data, descriptive statistical analysis will be used, since this facilitates in determining what the respondents believe about a topic/ issue. This involves identifying the central tendency (i.e. what most respondents believe) by finding the responses' mean and the spread/ dispersion (i.e. the extent to which they agree with each other) through the 'standard deviation'. The mean (i.e. the central value of a discrete set of numbers) can be approximated to show what the most likely response is, while the standard deviation is a measurement of the spread that indicates whether the responses are clustered or scattered across a wider range, offering an indication of consensus or contrast. Again, SPSS (v.24) was utilised to calculate these metrics.

5.6.2.1 Breakdown of the change management critical success factor

The respondents were asked to what extent they agreed or disagreed with the statement: *to manage change during the construction project lifecycle, it is important that I/ my organisation undertake the following activities*. Four components were presented, which emerged from the literature review as supporting the effective implementation of ISO 9001 in construction projects, and space was permitted for the respondents to add additional comments/ factors. The main question was considered as a critical success factor, and the options as factor components.

Table 5.9 and Figure 5.3 present the respondents' responses ranked by importance of the change management components based on what they believed is pertinent to support effective implementation of the ISO 9001 QMS in UK construction projects and to deliver a successful project.

Table 5.9: The importance of the change management components

Factor components		Strongly agree	Agree	Neither	Disagree	Strongly disagree	Mean	Std. deviation	Rank	Description
Determine the needs and expectations of stakeholders	N	48	42	11	19	0	4.26	.883	1	Strongly agree
	%	38.7%	33.9%	8.9%	15.3%	0%				
Monitor the needs and expectations of stakeholders	N	37	60	12	12	0	3.64	1.032	3	Agree
	%	29.8%	48.4%	9.7%	9.7%	0%				
Promote continual improvement	N	31	70	13	7	0	3.48	.958	4	Agree
	%	25%	56.5%	10.5%	5.6%	0%				
Plan for change	N	27	71	15	8	0	4.05	.784	2	Agree
	%	21.8%	57.3%	12.1%	6.5%	0%				
F10 Weighted Mean							4.0579			
F10 Std. Deviation								.49989		

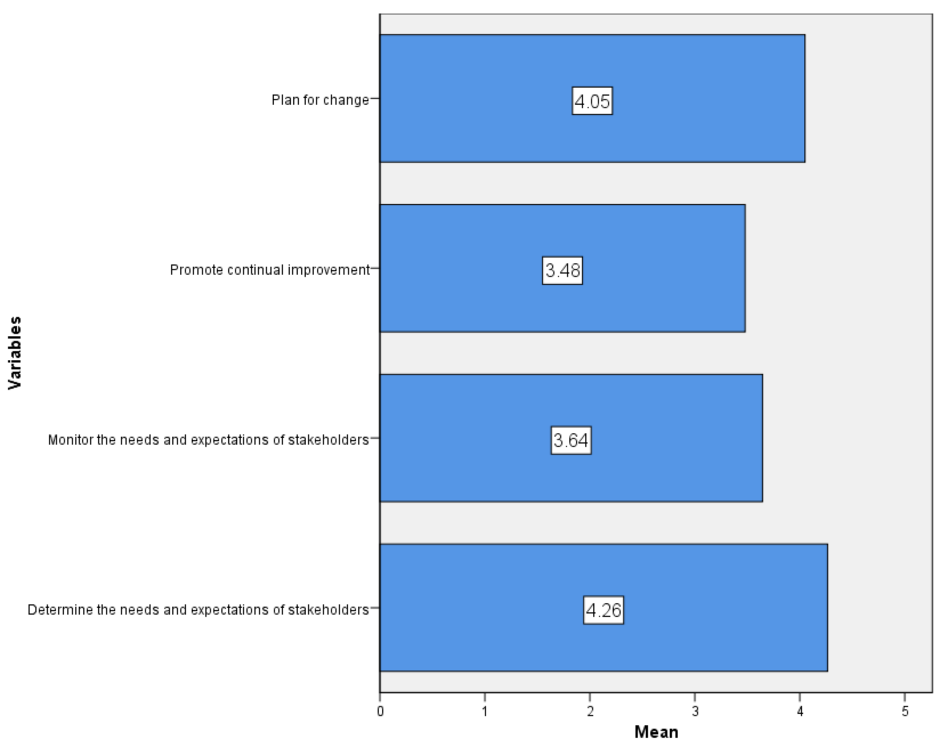

Figure 5.3: The importance of the change management critical success factor

From Table 5.9 and Figure 5.3 above, the highest average response was for the 'determine the needs and expectations of stakeholders' component (mean: 4.26, standard deviation: .883), while the third ranked component was 'monitor the needs and expectations of stakeholders' (mean: 3.64, standard deviation: 1.032). In his guide to the ISO 9001:2015 QMS, Abuhav (2017) cited the vital importance of meeting the client's needs and expectations to promote the organisation's development strategy and ensure that an effective QMS is implemented. He continued by underscoring the value of comprehending the needs of the various parties involved and to consider the conflicts that may arise in terms of their expectations. Takim (2009) carried out quantitative research of 93 respondents to explore the needs and expectations of project stakeholders in Malaysia, and found that interaction with the project client and final users throughout the project is vital, since the former inspire and fund the project, while the latter determine the project outcome's effectiveness.

'Plan for change' was the second ranked factor component (mean: 4.05, standard deviation: .784), where the participants agreed with its importance in terms of effective implementation of the ISO 9001 QMS in UK construction projects. This echoes the advice offered by Hoyle (2018) in his ISO handbook, revised to 9001:2015, where he stated that carrying out change without consideration of the implications, the feasibility, and how it should be implemented is not recommended, since changes in one area will have knock-on effects elsewhere in the project or organisation. The need to 'promote continual improvement' was also agreed upon by the project managers (mean: 3.48, standard deviation: .958), with Rumane (2018) referring to the required conditions whereby the environment must continue for the organisation's lifetime, with the methods thus being applied on a regular basis.

The weighted average of the change management critical success factor is 4.0579 with a standard deviation of .49989, which indicate that the importance of the change management components is agreed upon as a general trend based on the results from the Likert scale (see Table 5.1), as 3.8595 lies in the high-level interval range.

Therefore, the project managers accepted change management as a critical success factor to support effective implementation of the ISO 9001 QMS in UK construction projects. The literature review revealed that change management is the discipline that guides how we prepare, equip and support to enable the successful adoption of the change in order to drive the project's success and outcomes

(Motawa et al., 2007). With the construction industry based on projects, changes in these projects are frequent and typically manifest from a range of sources, due to various causes, which can emerge at any stage, and may impose significant negative effects on the costs and completion time (Lee et al., 2005; Hao et al., 2008; Karimidorabati et al., 2016). Critical changes can result in subsequent delays in the scheduling of the project, the need to re-estimate work and lead to additional demands for equipment, labour materials, and overtime. If unresolved via a formalised shift in the management process, change can represent the primary reason for disputes over contracts, which itself represents a severe risk that can contribute towards the failure of a project (McGeorge and Zou, 2012; Gharaee Moghaddam, 2013).

Table 5.10 presents the participants' additional comments for the change management critical success factor.

Table 5.10: Additional change management components identified

Comments	Frequency	Percent
Consider the organisational complexities and the ability of employees to change	1	6.67%
Raise awareness of how demanding change management processes can be	1	6.67%
Prioritise and post-implement review of the change	2	13.33%
Conduct change control	1	6.67%
The project team must be aware of how the change will affect them as individuals	1	6.67%
Anticipate change and address it effectively	2	13.33%
Predict the project environment and create contingency plans	3	20%
Educate clients and other stakeholders on the negative outcomes of unnecessary change	4	26.67%
Total	15	100%

Table 5.10 shows eight comments from the participants. '*Educate clients and other stakeholders on the negative outcomes of unnecessary change*' was asserted by four of the project managers in the quality management survey feedback. In terms of educating clients on the implications for

change, this is vital as they may not return for future work if they are not satisfied with the service or product provided (Hoyle, 2018), and thus they must be informed of the impact of their changes on the project's cost, quality, and completion time. Meanwhile, '*predict the project environment and create contingency plans*' and '*prioritise and post-implement review of the change*' were asserted by three and two of the project managers, respectively. Then, '*anticipate change and address it effectively*' was reported by two of the project managers in the quality management survey. In this context, Hoyle (2018) discussed the need to review change, which can occur before or after the change occurs, and will determine its suitability or effectiveness. The remainder of the comments were stated only once.

The following is a list of the components of the change management critical success factor according to the responses of the participants, supplemented by additional components of importance they added, where the repeated comments have been selected.

- Determine the needs and expectations of stakeholders
- Plan for change
- Monitor the needs and expectations of stakeholders
- Promote continual improvement
- Educate clients and other stakeholders on the negative outcomes of unnecessary change
- Predict the project environment and create contingency plans
- Anticipate change and address it effectively
- Prioritise and post-implement review of the change

5.6.2.2 Breakdown of the evidence-based decision-making critical success factor

The respondents were asked to what extent they agreed or disagreed with the statement: *in terms of decision-making for effective implementation of ISO 9001 in UK construction projects, it is important that I/ my organisation undertake a number of activities*. Eleven components were presented, which emerged from the literature review as supporting the effective implementation of ISO 9001 in construction projects, while space was permitted for the respondents to add additional comments/ factors.

Table 5.11 and Figure 5.4 present the respondents' responses ranked in order of the importance of the evidence-based decision-making components based on what they believed is pertinent to support effective implementation of the ISO 9001 QMS in UK construction projects and to deliver a successful project.

Table 5.11: The importance of the evidence-based decision-making components

Factor components		Strongly agree	Agree	Neither	Disagree	Strongly disagree	Mean	Std. deviation	Rank	Description
Analyse data through appropriate methods	N	86	31	3	0	1	4.66	.613	1	Strongly agree
	%	69.4%	25%	2.4%	0%	0.8%				
Use the analysis of processes data to inform decisions	N	53	54	5	9	0	4.25	.849	3	Strongly agree
	%	42.7%	43.5%	4%	7.3%	0%				
Evaluate the effectiveness of actions taken to address risks	N	56	53	2	1	0	4.33	.810	2	Strongly agree
	%	52.4%	42.7%	1.6%	0.8%	0%				
Evaluate the effectiveness of actions taken to address opportunities	N	58	53	2	8	0	3.72	.878	9	Agree
	%	46.8	42.7%	1.6%	6.5%	0%				
Monitor performance	N	14	60	26	18	3	3.53	.967	10	Agree
	%	11.3%	48.4%	21%	14.5%	2.4%				
Measure performance	N	34	64	0	14	9	4.02	.836	6	Agree
	%	27.4 %	51.6%	0%	11.3%	7.3%				
Analyse performance	N	37	62	14	7	1	4.05	.855	4	Agree
	%	29.8 %	50%	11.3%	5.6%	0.8%				
Conduct internal audits	N	35	66	11	8	1	4.04	.850	5	Agree
	%	28.2 %	53.2%	8.9%	6.5%	0.8%				
Evaluate individual performance	N	0	30	18	65	8	2.58	.938	11	Disagree
	%	0%	24.2%	14.5%	52.4%	6.5%				
Ensure access to exact and reliable data	N	38	55	11	15	2	3.93	.926	7	Agree
	%	30.6 %	44.4%	8.9%	12.1 %	1.6%				
	N	38	51	16	15	1	3.91	.988	8	Agree

Strike a balance between practical experience and data analysis	%	30.6 %	41.1 %	12.9%	12.1 %	0.8%				
F1 Weighted Mean								3.9098		
F1 Std. Deviation									.34687	

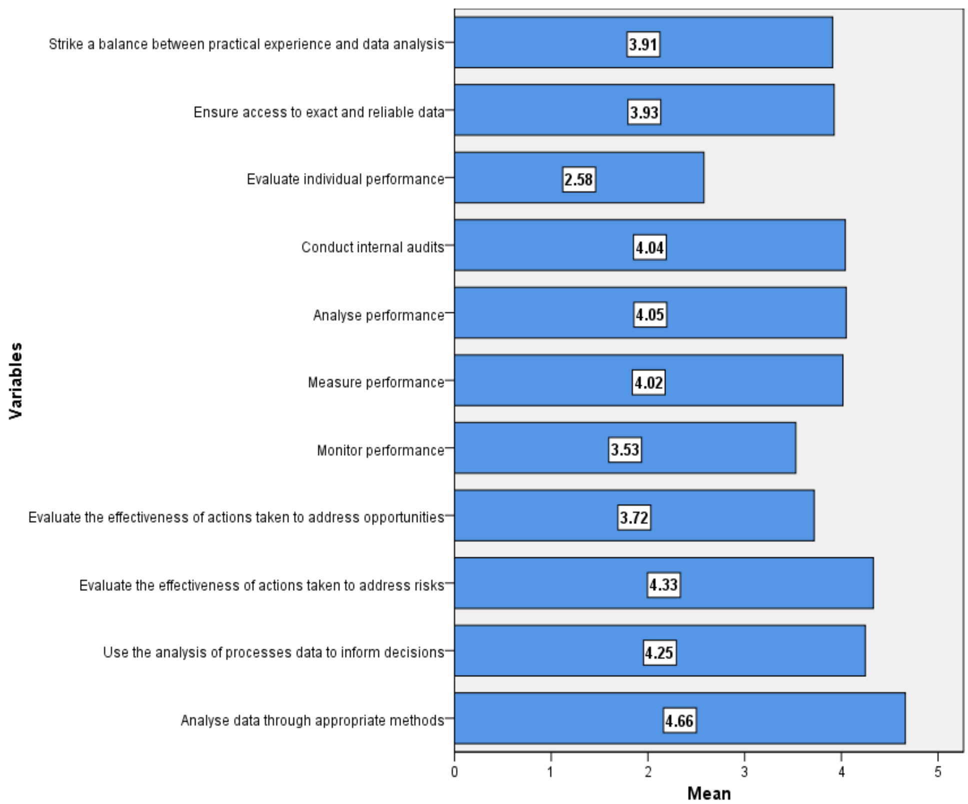

Figure 5.4: The importance of the decision-making critical success factor

From Table 5.11 and Figure 5.4 above, the highest average response was for the 'analyse data through appropriate methods' component (mean: 4.66, standard deviation: .613). Medić et al. (2016) highlighted the need to appraise actions in terms of their effectiveness through ensuring the availability of appropriate data to enhance the outcomes of strategic decision-making (see section 3.4.2.6). They suggested that data from sources such as audit reports, client complaints and risk assessments facilitate the management's ability to comprehend the QMS and conduct trend analysis.

The 'evaluate the effectiveness of actions taken to address risks' (mean: 4.33, standard deviation: .810) and 'evaluate the effectiveness of actions taken to address opportunities' (mean: 3.72, standard deviation: .878) components were ranked second and ninth, respectively, by the quality management survey respondents. Fonseca and Domingues (2017a) reported the major differences in the ISO 9001:2015, which include the encouragement of risk-based thought processes in terms of the threats and opportunities for the QMS and its desired outcomes, where these must be identified and managed. The 'use the analysis of processes data to inform decisions' component was ranked third by the project managers in the quality management survey (mean: 4.25, standard deviation: .849). Anttila and Jussila (2017) reported that ISO 9001:2015 contains the activities through which the objectives are identified by the organisation, and how the resources and processes necessary to achieve the desired outcomes are determined (see section 3.4.2.6).

The quality management survey respondents agreed with the importance of the 'analyse performance' (mean: 4.05, standard deviation: .855), 'measure performance' (mean: 4.02, standard deviation: .836) and 'monitor performance' (mean: 3.53, standard deviation: .967) components, ranked fourth, sixth and tenth, respectively. In term of analysing performance, Neyestani and Juanzon (2017a) asserted the need to explore the client's perspectives on product and service quality through metrics such as client satisfaction, the performance of suppliers and the organisation's share of the market (see section 3.4.2.6). Mansour et al. (2019) found that organisations should engage with QMPs in order to enhance their performance, which would thus require data collection to take place to facilitate measurement (see section 3.4.2.6). Finally, in their study, Willar et al. (2015) explored nine KPIs of ISO 9001-certified contractors, with six of these found to be relatively high, which included sales, product and service quality, profitability, and employee satisfaction (see section 3.4.2.6).

The lowest average was found to be the 'evaluate individual performance' component (mean: 2.58, standard deviation: .938), ranked in eleventh place out of eleven factor components. Thus, this component was excluded from the final list of critical success factor components, despite being identified by Hoyle (2018) as an important component of decision-making, where he advised that by monitoring performance it can be possible to prepare for action when unanticipated changes manifest, with clause 9.1.1 of the ISO 9001:2015 standard stating the need to evaluate the performance and effectiveness of the QMS.

Overall, the weighted average of the critical success factor of evidence-based decision-making is 3.9098, with a standard deviation of .34687, which indicates that the trend of the importance of the decision-making components is agreed upon as a general trend based on the results from the Likert scale (see Table 5.1), as 3.9098 is located in the high-level interval range. This means that the participants accepted evidence-based decision-making as a critical success factor to support the effective implementation of the ISO 9001 QMS in UK construction projects, whilst they rejected one component. This corresponds to the literature, where Scherer and Schapke (2011) revealed that the process of making decisions is vital to a construction project's success, whereby the project's personnel must make daily decisions and be able to justify these, since incorrect or inappropriate decisions can impose additional pressures in terms of cost, quality, relationships, and time, while decisions must be assessed in light of the importance and urgency, and addressed accordingly, for time management to be effective (Jato-Espino et al., 2014; Książek et al., 2015). It is thus crucial for decision-making to be informed to assure that construction projects achieve successful completion. Such decision-making manifests at every project stage; for example, at the outset of the construction phase, where decisions are made to determine the required construction activities and methods that will allow the work to be completed and to prepare the plans necessary to carry these out. Such decisions can significantly impact the work in terms of the performance and could mean the difference between the profitable completion of a project or making a loss due to the incidence of failure costs, particularly in the case of a contracting company. Ultimately, consideration of all the variants of activities, sequences, and potential approaches to a construction project is complex, since the possible alternatives can increase significantly, and each will entail its own particular risks (Ellingham and Fawcett, 2007; Ning et al., 2011).

Table 5.12 presents the participants' additional comments on the critical success factor of evidence-based decision-making.

Table 5.12: Additional evidence-based decision-making components identified

Comments	Frequency	Percent
Avoid jumping to conclusions before having all the information, as this may lead to frustrating other stakeholders	2	18.18%
Understand the process by which decisions are formed and monitor the outcome to ensure smooth progression	2	18.18%
Determine the requirements to be fulfilled and gather information on options that satisfy requirements, to [allow] comparison	1	9.09%
Commit to decisions and follow through with them	1	9.09%
Knowledge and experience are required for decision-making	1	9.09%
Combine methods of dialogue, discussion, negotiation, research and analysis for decision-making	3	27.27%
Combining all the appropriate tools and techniques, while taking advantage of the available knowledge	1	9.09%
Total	11	100%

Table 5.12 presents seven comments from the participant project managers, where '*combine methods of dialogue, discussion, negotiation, research and analysis for decision-making*' was cited three times by project managers, which links to Abuhav's (2017) claim that the quality objectives need to underpin decision-making, with the information and collected data enabling managers at the organisation from a range of levels to form QMS-related decisions. Then, '*avoid jumping to conclusions before having all the information, as this may lead to frustrating other stakeholders*' and '*understand the process by which decisions are formed and monitor the outcome to ensure smooth progression*' were each mentioned twice, while the remaining the comments were only made once.

In summary, the following is a list of components related to the decision-making critical success factor according to the responses of the project managers:

- Analyse data through appropriate methods
- Evaluate the effectiveness of actions taken to address risks

- Use the analysis of processes data to inform decisions
- Analyse performance
- Conduct internal audits
- Measure performance
- Ensure access to exact and reliable data
- Strike a balance between practical experience and data analysis
- Evaluate the effectiveness of actions taken to address opportunities
- Monitor performance
- Combine methods of dialogue, discussion, negotiation, research and analysis for decision-making
- Avoid jumping to conclusions before having all the information, as this may lead to frustrating other stakeholders
- Understand the process by which decisions are formed and monitor the outcome to ensure smooth progression

5.6.2.3 Breakdown of the client focus critical success factor

The respondents were asked to what extent they agreed or disagreed with the statement: *addressing client focus in construction projects, it is important that I/ my organisation undertake the following activities*. Seven components were presented, which emerged from the literature review as supporting the effective implementation of ISO 9001 in construction projects, and space was permitted for the respondents to add additional comments/ factors.

Table 5.13 and Figure 5.5 present the respondents' responses ranked by importance based on what they believed is pertinent to support effective implementation of the ISO 9001 QMS in UK construction projects and to deliver a successful project.

Table 5.13: The importance of the client focus components

Factor components		Strongly agree	Agree	Neither	Disagree	Strongly disagree	Mean	Std. deviation	Rank	Description
Understand the current clients' requirements	N	67	32	6	15	1	4.23	1.063	1	Strongly agree
	%	54%	25.8%	4.8%	12.1%	0.8%				
Understand future clients' requirements	N	53	50	4	12	2	4.16	1.000	3	Agree
	%	42.7%	40.3%	3.2%	9.7%	1.6%				
Measure client satisfaction	N	52	55	11	14	0	4.02	.949	4	Agree
	%	33.1 %	44.4%	8.9%	11.3%	0%				
Exceed client expectations	N	0	34	7	74	6	2.57	.956	6	Disagree
	%	0%	27.4 %	5.6%	59.7%	4.8%				
Focus on the intangible advantages to increased client satisfaction	N	0	32	12	68	9	2.55	.966	7	Disagree
	%	0%	25.8%	9.7%	54.8 %	7.3%				
Ensure the project objectives match the client's requirements	N	47	57	14	3	0	4.22	.747	2	Strongly agree
	%	37.9%	46%	11.3%	2.4%	0%				
Ensure the project objectives match the client's expectations	N	39	55	17	9	1	4.01	.917	5	Agree
	%	31.5%	44.4%	13.7%	7.3%	0.8%				
F2 Weighted Mean							3.6800			
F2 Std. Deviation								.48023		

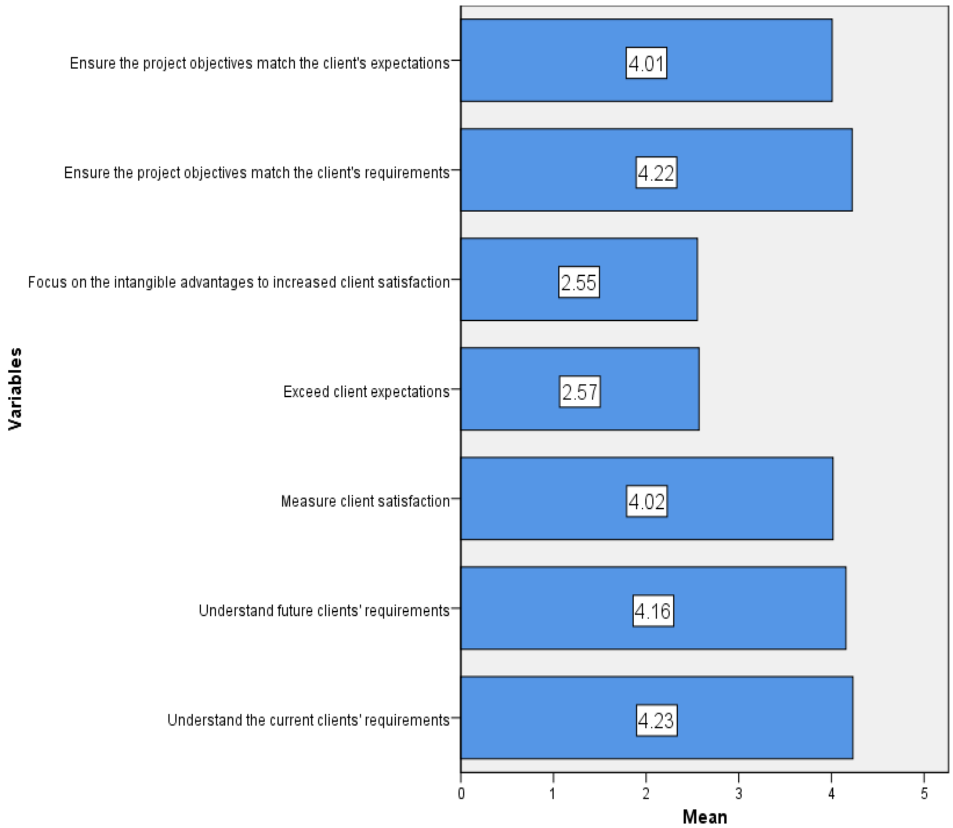

Figure 5.5: The importance of the client focus critical success factor

From Table 5.13 and Figure 5.5 above, we find that the highest mean was for the 'understand the current clients' requirements' factor component (mean: 4.23, standard deviation: 1.063), while 'understand the future clients' requirements' was ranked third (mean: 4.16, standard deviation: 1.000). In Luburić's (2015) paper exploring QMPs and how central banks can benefit through their implementation (see section 3.4.2.1), the notion of customer focus is proposed as a critical component of success for business, and particularly the need to comprehend current and future clients' needs in order to raise revenue and the market share, increase customer satisfaction and enhance customer loyalty, which then translates into future work.

Ranked second was the 'ensure the project objectives match the client's requirements' component (mean: 4.22, standard deviation: .747), while 'ensure the project objectives match the client's expectations' was ranked fifth (mean: 4.01, standard deviation: .917), to which the participants strongly agreed and agreed, respectively. In their research paper that explored the success of ISO

9001 in meeting its aims of alignment with modern concepts of management and quality management, as well as offering added value, Fonseca and Domingues (2017a) underscored that both the ISO 9000 and ISO 9001 editions assert that the key QMP in the context of client focus is to meet new clients' requirements and aim to surpass them (see section 3.4.2.1). Their quantitative research surveyed 393 auditors from 71 nations, and their study found that ISO 9001 is aligned with contemporary concepts of modern quality and business management.

Hoyle (2018) reported that client satisfaction is one of the ISO 9001 objectives (see section 3.4.2.1), and thus it is of vital importance for companies to gather data on the perspectives of their clients. Failure to do so represents negligence in his view, since organisations cannot survive without their clients. This perception was agreed upon by the project managers in their responses to the quality management survey regarding the 'measure client satisfaction' factor component (mean: 4.02, standard deviation: .949), which was ranked fourth.

The lowest average was found to be 'focus on the intangible advantages to increased client satisfaction' component (mean: 2.55, standard deviation: .966), in contrast to the literature that supported this component, with Shaari et al. (2015) underscoring it as an important element to increase customer interest. This was followed by the 'exceed client expectations' component (mean: 2.57, standard deviation: .956), where the respondents disagreed with both. This means that the rate of importance of these two components was weak among the respondents, and thus these will be excluded from the final list of critical success factor components.

The weighted average of the client focus critical success factor is 3.6800 with a standard deviation of .48023, which indicates the importance of the client focus critical success factor for effective ISO 9001 implementation in UK construction projects as the weighted mean from the Likert scale (3.6800) is in the high-level interval range (see Table 5.1).

This means that the participants accepted client focus as a critical success factor to support the effective implementation of ISO 9001 in UK construction projects, although excluding two of the components of this factor. This is supported by the literature, where it was revealed that client satisfaction (see section 3.4.2.1) is significant in terms of quality improvement within the construction industry, representing a vital element in developing and managing the construction process, together with the creation of a company–client relationship that is efficient. Moreover, the satisfaction of the client has a positive impact on their retention, which is a vital outcome for any organisation (Omonori and Lawal, 2014; Luburić, 2015). The construction industry faces considerable criticism resulting from the overrun of costs, delays in the project's completion, high rates of accident, and unsatisfactory project performance that negatively affect client satisfaction, and which thus represents a key facet in the context of developing the construction process and client relationships. As a result of the inherent competition in the sector of construction, significant attention has been placed on client relationships and client satisfaction (Durai Anand Kumar, 2011; Fonseca and Domingues, 2017a).

Table 5.14 below presents the participants' additional contributions to the client focus critical success factor.

Table 5.14: Additional client focus components identified

Comments	Frequency	Percent
Act after listening and work on solving client's problems and responding to their questions	1	9.09%
Clients are treated with respect and courtesy and empathise with their situation	4	36.36%
Take responsibility for the situation, even if things cannot be fixed	1	9.09%
Do not leave the client waiting and let them know what is being done, commit to responding	2	18.18%
Ensure that your team translates the client's needs into specifications	1	9.09%
Conduct external measurements and surveys for the client's needs and engage seriously with the results	2	18.18%
Total	11	100%

Table 5.14 shows six additional comments from the participants. '*Clients are treated with respect and courtesy and empathise with their situation*' was mentioned by four respondents, which indicates its importance to the project managers, as well as '*conduct external measurements and surveys for the client's needs and engage seriously with the results*' and '*do not leave the client*

waiting and let them know what is being done, commit to responding', which were each listed twice, while the remaining comments were only stated once. This links to Abuhav (2017), who reminded that one of ISO 9001's goals is to enhance client satisfaction by meeting their needs to ensure the organisation's survival and the likelihood of repeat work, as well as carrying out surveys and market research to fully comprehend their expectations. Rumane (2018) highlighted the importance of taking great steps to assure that client satisfaction is achieved, particularly since the nature of construction is typically a unique project as opposed to the long-term relationships seen between clients and suppliers.

The following is a list of the components of the client focus critical success factor according to the responses of the project managers, supplemented by additional components they added; repeated additional comments have been included, and some components have been removed because of their low rating according to the Likert scale responses:

- Understand the current clients' requirements
- Ensure the project objectives match the client's requirements
- Understand future clients' requirements
- Measure client satisfaction
- Ensure the project objectives match the client's expectations
- Clients are treated with respect and courtesy and empathise with their situation
- Do not leave the client waiting and let them know what is being done, commit to responding
- Conduct external measurements and surveys for the client's needs and engage seriously with the results

5.6.2.4 Breakdown of the reduce the impact of non-standardisation critical success factor

The respondents were asked to what extent they agreed or disagreed with the statement: *to reduce the impact of non-standardisation during the construction project lifecycle, it is important that I/ my organisation undertake the following*. Three components were presented, which emerged from the literature review as supporting the effective implementation of ISO 9001 in construction projects, and space was permitted for the respondents to add additional comments/ factors.

Table 5.15 and Figure 5.6 present the respondents' responses ranked by importance of the non-standardisation components based on what they believed is pertinent to support effective implementation of the ISO 9001 QMS in UK construction projects and to deliver a successful project.

Table 5.15: The importance of reducing the impact of non-standardisation components

Factor components		Strongly agree	Agree	Neither	Disagree	Strongly disagree	Mean	Std. deviation	Rank	Description
Develop quality system documentation	N	0	15	23	71	12	2.34	.822	2	Disagree
	%	0%	12.1%	18.5%	57.3%	9.7%				
Enhance quality system documentation	N	0	14	21	73	13	2.30	.813	3	Disagree
	%	0%	11.3%	16.9%	58.9%	10.5%				
Improve the efficiency of processes through documentation	N	0	71	6	36	8	3.16	1.065	1	Agree
	%	0%	57.3%	4.8%	29%	6.5%				
F3 Weighted Mean							2.5758			
F3 Std. Deviation								.61313		

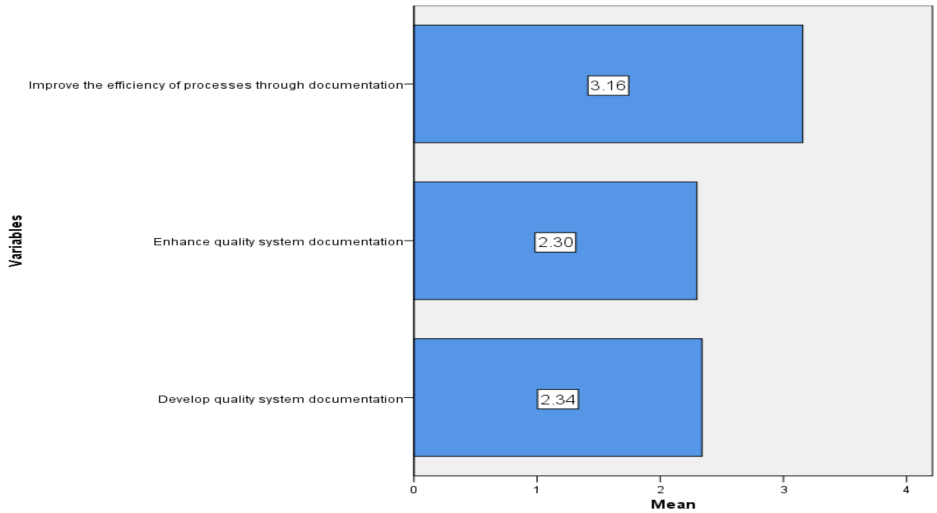

Figure 5.6: The importance of the reduce impact of non-standardisation critical success factor

From Table 5.15 and Figure 5.6 above, the highest average response was for the 'improve the efficiency of processes through documentation' component (mean: 3.16, standard deviation: 1.065). This component was confirmed by Ramaji and Memari (2015) as being important to the application of quality standards in the project, where in their article on the standardisation of information exchange in the construction of residential buildings they reported that costs and complexity can be reduced through increasing the degree of information exchange in the construction sector, particularly through BIM (see section 3.3.1.4).

The lowest average was found to be the 'enhance quality system documentation' component (mean: 2.30, standard deviation: .813), followed by the 'develop quality system documentation' component (mean: 2.34, standard deviation: .822), where both were disagreed with. This means that the rate of importance of these two components was weak among the respondents, and thus they are rejected as critical success factors, despite Rumane (2018) asserting the need for the quality plan as a component of the overall project documentation to include (i) clearly defined specifications of the materials and equipment to be used, (ii) detailed plans and work procedures for the construction project, (iii) information on the quality standards that require compliance, and (iv) the project cost and schedule. It is possible that the quality management survey respondents were not specifically engaged in the creation of quality system documentation, and thus this held less importance for them than other components in terms of achieving a successful project outcome.

The weighted average of the non-standardisation critical success factor is 2.5758 with a standard deviation of .61313, which indicates that the importance of reducing the impact of non-standardisation during a UK construction project's lifecycle is disagreed with as a general trend based on the results from the Likert scale (see Table 5.1), as 2.5758 lies in the low-level interval range.

This means that the participants rejected reducing the impact of non-standardisation as a critical success factor to support effective implementation of the ISO 9001 QMS in UK construction projects, although this will need to be validated in the next stage of the research. This is contrary to the literature, which asserted that standardised work can eliminate unnecessary risks in the process, including injury reduction and stress, and allows the determination of what is repeatable and to develop guidance on the procedures identified. Standardisation is the process of creating and recording a specific group of responses to actually or potentially benefit the party or interested parties from companies and stakeholders to balance their needs, where these solutions will be used frequently or during the lifetime of the project (Gibb and Isack, 2001; Perumal and Bakar, 2011; Ramaji and Memari, 2015). Customers may have standard processes, and companies and suppliers produce standardised elements or custom components with standardised components through standardised procedures (Egan, 1998; Gibb and Isack, 2001; Münstermann and Weitzel, 2008).

Table 5.16 presents the participants' additional comments for the reduce the impact of non-standardisation critical success factor.

Table 5.16: Additional non-standardisation components identified

Comments	Frequency	Percent
Standards and binding regulations must be included in contracts	2	28.57%
Contract with a legal review team	1	14.29%
Measure the market's requirements	1	14.29%
Participate and discuss with stakeholders and the project team during the project activities	1	14.29%
Contract with consultants during the project lifecycle	2	28.57%
Total	7	100%

Table 5.16 presents five comments from the participants. '*Standards and binding regulations must be included in contracts*' was mentioned twice, which agrees with Abuhav's (2017) assertion that ISO 9001 requires organisations to take measures so that all processes, products and services that are provided by external organisations meet the stipulated requirements. Two project managers reported on the need to '*contract with consultants during the project lifecycle*', most likely to ensure the continuity of their services and benefit from their knowledge of the project that will develop as it and their input progresses. The rest of the comments were listed only once.

In summary, the following list of components related to the reduce the impact of non-standardisation critical success factor were identified as critical according to the responses of the project managers:

- Improve the efficiency of processes through documentation
- Standards and binding regulations must be included in contracts
- Contract with consultants during the project lifecycle

5.6.2.5 Breakdown of the engage the project team critical success factor

The respondents were asked to what extent they agreed or disagreed with the statement: *to engage the project team in construction projects, it is important that I/ my organisation undertake the following activities*. Seven components were presented, which emerged from the literature review as supporting the effective implementation of ISO 9001 in construction projects, and space was permitted for the respondents to add additional comments/ factors.

Table 5.17 and Figure 5.7 present the respondents' responses ranked by importance of the engage the project team components based on what they believed is pertinent to support the effective implementation of the ISO 9001 QMS in UK construction projects and to deliver a successful project.

Table 5.17: The importance of the engage the project team components

Factor components		Strongly agree	Agree	Neither	Disagree	Strongly disagree	Mean	Std. deviation	Rank	Description
Facilitate the open discussion of issues	N	58	47	2	11	3	4.21	1.024	2	Strongly agree
	%	46.8 %	37.9%	1.6%	8.9%	2.4%				
Facilitate the open discussion of barriers	N	47	63	3	7	1	4.22	.821	1	Strongly agree
	%	37.9%	50.8%	2.4%	5.6%	0.8%				
Enhance the motivation of personnel	N	34	55	17	14	1	3.88	.976	4	Agree
	%	27.4%	44.4%	13.7%	11.3%	0.8%				
Promote quality issues through efficient teamwork	N	0	37	5	70	9	2.58	1.006	6	Disagree
	%	0%	29.8 %	4%	56.5%	7.3%				
Increase employee satisfaction	N	1	42	4	50	24	2.55	1.183	7	Disagree
	%	0.8%	33.9%	3.2%	40.3%	19.4%				
Ensure that employees' abilities are utilised	N	42	58	4	13	4	4.00	1.057	3	Agree
	%	33.9%	46.8%	3.2%	10.5%	3.2%				
Ensure that employees' abilities are valued	N	0	43	6	51	21	2.59	1.145	5	Disagree
	%	0%	34.7%	4.8%	41.1%	16.9 %				
F4 Weighted Mean							3.4333			
F4 Std. Deviation								.50303		

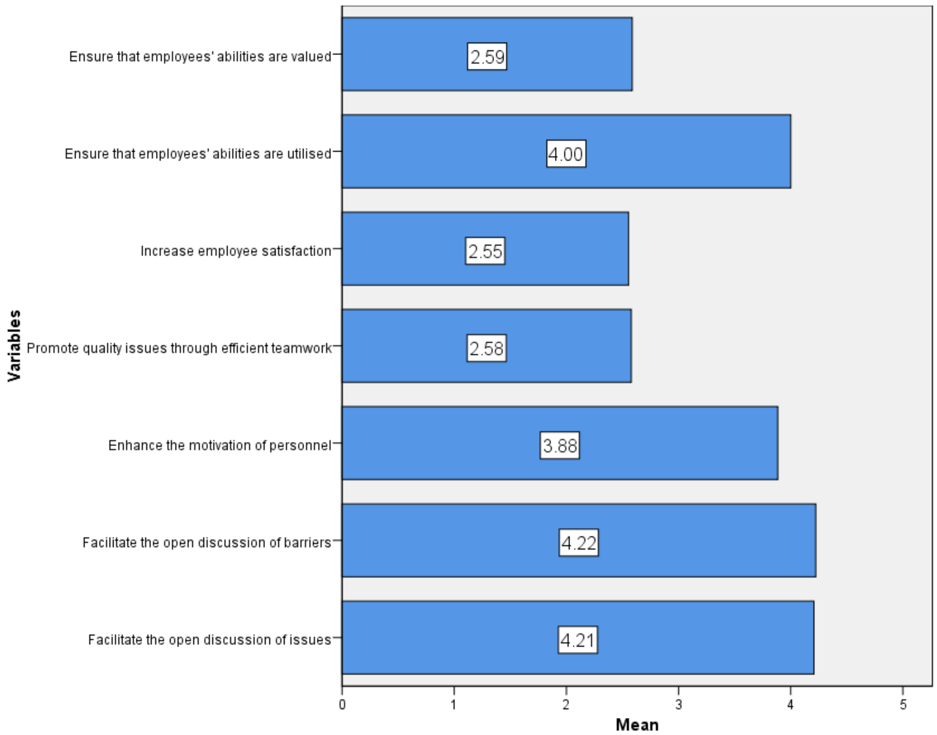

Figure 5.7: The importance of the engage the project team critical success factor

From Table 5.17 and Figure 5.7 above, the highest average response was for the 'facilitate the open discussion of barriers' component (mean: 4.22, standard deviation: .821). This is consistent with the literature, where in their research on the influence of QMPs on staff in high-end Egyptian hotels, Mansour et al. (2019) underscored the importance of facilitating the open discussion of barriers to support the participation of the project team (see section 3.4.2.3), whereby the ISO 9001:2008 standard encourages people to recognise their limitations, and to take responsibility for addressing them, while proactively aiming to enhance their own ability, experience and knowledge. This component was followed by 'facilitate the open discussion of issues' (mean: 4.21, standard deviation: 1.024) as the next highest-rated identified component, which links to Fonseca and Domingues's (2017a) study where they reported that a significant difference in ISO 9001:2015 is awareness of the external and internal problems that may impede the organisation's capacity to meet its objectives via the QMS.

'Ensure that employees' abilities are utilised' was agreed upon by the project managers (mean: 4.00, standard deviation: 1.057) and ranked third in importance. Röyttä (2016) explored the requirements of small and medium-sized enterprises (SMEs) in terms of acquiring ISO 9001 accreditation, stating that organisations must ensure that they have sufficient employees who have the required capabilities to manage and control the processes of the QMS. Ranked fourth and also agreed upon by the project managers was 'enhance the motivation of personnel' (mean: 3.88, standard deviation: .976), with Mansour et al. (2019) asserting the need to place emphasis on the motivation and sense of inclusion of those within the organisation (see section 3.4.2.3).

The lowest average was found to be the 'increase employee satisfaction' component (mean: 2.55, standard deviation: 1.183), where the standard deviation here indicates that there was no consensus among the respondents (i.e. 33.9% agreed, while 40.3% disagreed and 19.4% strongly disagreed). This is contrary to the literature, where Röyttä (2016) supported this component and considered it important to support the participation of the project team. This component was followed by 'promote quality issues through efficient teamwork' (mean: 2.58, standard deviation: 1.006) as the next lowest-rated identified component, and then by 'ensure that employees' abilities are utilised' (mean: 2.59, standard deviation: 1.145), where the participants disagreed with the importance of each of these. This means that the rate of importance of these three components was deemed to be weak among the respondents, and thus these will be excluded from the final list of critical success factor components.

The weighted average of the engage the project team critical success factor is 3.4333, with a standard deviation of .50303, which implies that the importance of engaging the project team to ensure the effective implementation of the ISO 9001 in UK construction projects is agreed upon as a general trend based on the results from the Likert scale (see Table 5.1), as 3.4333 lies in the high-level interval range.

Therefore, the project managers accepted the engage the project team as a critical success factor to support effective implementation of the ISO 9001 QMS in UK construction projects, while rejecting three of the components of this factor. The literature review revealed that the project team must assure that all staff members have the required ability and deliver value via engagement and empowerment, which enhances its value-creation potential (Willar et al., 2015). When engaged, personnel are focused on the goals and values of their project, being driven towards making a contribution to the project's success while simultaneously enhancing their well-being. Moreover, they experience commitment to the organisation, empowerment, role involvement, and satisfaction (Sickinger-Nagorni and Schwanke, 2016), whilst being competent, delivering value, and being very clear of their role's importance (Fonseca and Domingues, 2017a), since engaged personnel have a heightened perception of this. There should be more opportunities for career development, alongside regular dialogue and feedback with supervisors. Ultimately, engaged employees have higher quality relationships with their colleagues, managers, and subordinates due to the more effective communication (Röyttä, 2016).

Table 5.18 presents the participants' additional comments for the engage the project team critical success factor.

Table 5.18: Additional engage the project team components identified

Comments	Frequency	Percent
Build trust between the project team and project leadership and between teams	2	15.38%
Clarify work priorities and define the roles and responsibilities of the project team	3	23.08%
Involve people with ideas and encourage them to provide their perspectives and encourage groupthink	2	15.38%
Efficient communication mechanisms are crucial to developing an effective project team	1	7.69%
Carry out cyclical meetings to review the project status, to inform the team on progress and monitor for conflict	3	23.08%
Explore the project's components and discuss clearly the project's importance with staff members	2	15.38%
Total	13	100%

Table 5.18 shows six comments from the participants. '*Clarify work priorities and define the roles and responsibilities of the project team*' was raised by three of the project managers. ISO 9001 involves the expectation that every individual within an organisation has a clear understanding of

his or her role and responsibility, with Abuhav (2017) advising that all roles are clearly defined in terms of (i) identifying the function, (ii) who the role must report to, (iii) the responsibilities involved, (iv) what authority is included, and (v) the competency regarding external and internal qualifications. Furthermore, Hoyle (2018) discussed the importance of communication regarding roles and responsibilities, whereby individuals are not merely informed of what they need to do and the results that are expected, but they are also clear of their obligations so there can be no misunderstanding. The need to '*carry out cyclical meetings to review the project status, to inform the team on progress and monitor for conflict*' was addressed by Rumane (2018), who highlighted that once the project has commenced, frequent monitoring is vital to ensure that the project's objectives are being achieved in terms of time, resources, and the budget, while employing interdisciplinary coordination to overcome any conflicts that arise.

Comments raised twice by the respondents included the need to '*build trust between the project team and project leadership and between teams*'. In their research into teamwork that involved 28 participants from 5 multi-disciplinary teams who self-completed questionnaires, Chiocchio et al. (2011) found that collaboration helps to increase the development of trust while reducing the negative impacts of conflict, resulting in considerably enhanced performance. They go on to discuss the specific learning domains of construction professionals such as architects and engineers, and the need for academic institutions to promote opportunities for interdisciplinary collaboration to create valuable spaces to develop experiences of collaboration, conflict and trust. Then, '*involve people with ideas and encourage them to provide their perspectives and encourage groupthink*' was cited. In their research exploring how Indonesian construction companies implement ISO 9001, Willar et al. (2015) distributed a quantitative questionnaire to Indonesian ISO 9001-certified construction companies, with 77 instruments completed by top, middle, and lower management levels. Their study found that the necessary criteria for the implementation of QMSs such as ISO 9001 in order to offer effective resolution to issues that arise while promoting high standards in terms of quality include (i) robust commitment, (ii) the effective participation and engagement of personnel, and (iii) the strong promotion of both internal and external communication. These factors must be applied at all levels of the company structure, and will help to develop the organisational culture, that in turn will help to address existing barriers to the effective implementation of the ISO 9001 QMS. Finally, '*explore the project's components and discuss clearly the project's importance with staff members*' was also mentioned twice. Abuhav

(2017) highlighted the emphasis on awareness in ISO 9001:2015, whereby employees should be aware of their own actions and the impact of these within the QMS domain, and thus to focus on opportunities to develop this awareness in all staff members at all organisational levels. The rest of the quality management survey comments were only stated once.

The following is a list of the critical components of the engage the project team critical success factor according to the responses of the project managers, supplemented by additional components of importance they added, where the repeated comments have been selected, and certain components have been deleted because of their low rating according to the Likert scale responses:

- Facilitate the open discussion of barriers
- Facilitate the open discussion of issues
- Ensure that employees' abilities are utilised
- Enhance the motivation of personnel
- Clarify work priorities and define the roles and responsibilities of the project team
- Carry out cyclical meetings to review the project status, to inform the team on progress and monitor for conflict
- Build trust between the project team and project leadership and between teams
- Involve people with ideas and encourage them to provide their perspectives and encourage groupthink
- Explore the project's components and discuss clearly the project's importance with staff members.

5.6.2.6 Breakdown of the leadership critical success factor

The respondents were asked to what extent they agreed or disagreed with the statement: *to promote construction project leadership, it is important that I/ my organisation undertake the following activities*. Twelve components were presented, which emerged from the literature review as supporting the effective implementation of ISO 9001 in construction projects, and space was permitted for the respondents to add additional comments/ factors.

Table 5.19 and Figure 5.8 present the respondents' responses ranked by importance of the project leadership components based on what they believed is pertinent to support effective implementation of the ISO 9001 QMS in UK construction projects and to deliver a successful project.

Table 5.19: The importance of the construction project leadership components

Factor components		Strongly agree	Agree	Neither	Disagree	Strongly disagree	Mean	Std. deviation	Rank	Description
Establish a vision for the project	N	66	46	2	5	2	4.40	.851	1	Strongly agree
	%	53.2 %	37.1%	1.6%	4%	1.6%				
Establish a pathway for the project	N	37	61	14	7	2	4.02	.899	4	Agree
	%	29.8%	49.2%	11.3 %	5.6%	1.6%				
Empower employees	N	0	36	6	67	12	2.55	1.025	12	Disagree
	%	0%	29%	4.8%	54%	9.7%				
Equip employees	N	31	74	6	10	0	4.04	.800	3	Agree
	%	25%	59.7%	4.8%	8.1%	0%				
Create trust with employees	N	38	59	11	12	1	4.00	.940	5	Agree
	%	30.6 %	47.6%	8.9%	9.7%	0.8%				
Ensure commitment to the role	N	37	63	11	10	0	4.05	.855	2	Agree
	%	29.8%	50.8%	8.9%	8.1%	0%				
Ensure commitment to policy	N	35	58	9	19	0	3.90	.995	7	Agree
	%	28.2%	46.8%	7.3%	15.3%	0%				
Ensure responsibility to project partners	N	36	59	10	16	0	3.95	.956	6	Agree
	%	29%	47.6%	8.1%	12.9%	0%				
Reduce the environmental impact	N	0	35	9	68	9	2.58	.990	11	Disagree
	%	0%	28.2%	7.3%	54.8%	7.3%				
Identify challenging targets	N	33	62	8	16	2	3.89	1.007	8	Agree
	%	26.6%	50%	6.5%	12.9%	1.6%				
Promote high-quality processes	N	1	35	11	61	13	2.59	1.046	10	Disagree
	%	0.8%	28.2%	8.9%	49.2%	10.5%				

Ensure the efficient use of resources	N	38	53	6	22	2	3.85	1.108	9	Agree
	%	30.6%	42.7%	4.8%	17.7%	1.6%				
F5 Weighted Mean							3.6515			
F5 Std. Deviation								.43381		

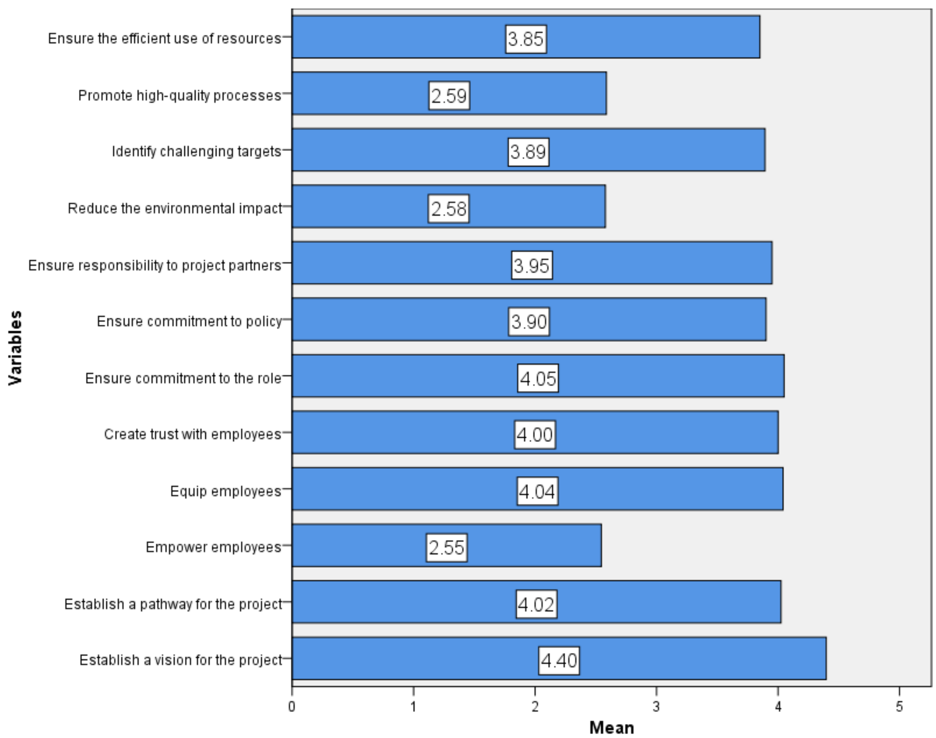

Figure 5.8: The importance of the construction project leadership critical success factor

From Table 5.19 and Figure 5.8 above, the highest average response was for the 'establish a vision for the project' component (mean: 4.40, standard deviation: .851), with 'establish a pathway for the project' ranked fourth (mean: 4.02, standard deviation: .899), and the participants strongly agreeing and agreeing, respectively. This links back to the literature, where in their study exploring the procedures necessary for the effective implementation of the ISO/TS 29001:2010 QMS in the context of manufacturers in Croatia, Medić et al. (2013) underscored the importance of determining the vision and pathway prior to the project commencing (see section 3.4.2.2). 'Ensure commitment to the role' (mean: 4.05, standard deviation: .855) was the second highest-rated identified component, with Mansour et al. (2019) discussing the leadership QMP and stating that the aim of leadership is to provide optimum behaviours that exemplify best practice and that meet the organisation's objectives (see section 3.4.2.2).

In their literature review exploring the ISO 9001 standard and organisational performance, Neyestani and Juanzon (2017b) underscored the importance that ISO 9001 places on the personnel's awareness of quality issues and encouraging continuous professional development (see section 3.4.2.2), thus improving employees' satisfaction by equipping them with the scope to create new skills and advance their learning. In this context, the quality management survey respondents agreed on the importance of the 'equip employees' component (mean: 4.04, standard deviation: .800), ranking it third in importance. 'Create trust with employees' was ranked fifth in importance (mean: 4.00, standard deviation: .940). Chiocchio et al. (2011) reported that the link between trust and performance increases over time, as does the relationship between trust and collaboration (see section 3.4.2.2). Therefore, developing an environment of trust between the leadership and employees is vital to the overall objective of the effective implementation of the ISO 9001 QMS.

In their paper on risk management's role in ISO 9001, Sitnikov and Bocean (2015) underscored that ISO 9001's primary objectives remain unchanged in terms of increasing the confidence in the organisation's ability to offer the required products and services, as well as enhanced customer satisfaction (see section 3.4.2.2). This was agreed upon by the project managers in the quality management survey in terms of the 'ensure responsibility to project partners' component, which was ranked sixth (mean: 3.95, standard deviation: .956). The seventh ranked 'ensure commitment to policy' component was also agreed upon by the project managers (mean: 3.90, standard deviation: .995), with Jabnoun and Sedrani's (2005) investigation into TQM, culture, and performance in United Arab Emirate manufacturers utilising a questionnaire distributed to managers, where the 81 responses revealed that the commitment of management to quality was correlated to a significant degree with all business and quality performance.

Regarding the need for leadership to 'identify challenging targets', this was also agreed upon (mean: 3.89, standard deviation: 1.007) and echoed by Sickinger-Nagorni and Schwanke (2016), who stated the importance of the QMS supporting the orientation of all activities towards the organisational objectives to ensure that the firm continues to be competitive in the market (see section 3.4.2.2). Moreover, Hoyle (2018) asserted that top management can demonstrate that they are leading the organisation with regard to the QMS by establishing challenging goals and targets. Jabnoun and Sedrani (2005) discussed the need to 'ensure the efficient use of resources' (see section 3.4.2.2), which was supported by the project manager respondents in the quality management survey who agreed with this factor component (mean: 3.85, standard deviation: 1.108).

The lowest average was found to be the 'empower employees' component (mean: 2.55, standard deviation: 1.025), despite Neyestani and Juanzon (2017b) underscoring this as one of the tasks of the project leadership. This component was followed by 'reduce the environmental impact' (mean: 2.58, standard deviation: .990), and 'promote high-quality processes' (mean: 2.59, standard deviation: 1.046) as the next lowest-rated identified components, where the participants disagreed with all three components. This means that the rate of importance of these three components was weak among the respondents, and thus these will be excluded from the final list of critical success factor components.

The weighted average of the construction project leadership critical success factor is 3.6515 with a standard deviation of .43381, which indicates that the importance of the construction project leadership components is agreed upon as a general trend based on the results from the Likert scale (see Table 5.1), as 3.6515 lies in the high-level interval range.

Therefore, the project managers accepted leadership as a critical success factor to support effective implementation of the ISO 9001 QMS in UK construction projects, while rejecting three of the components of this factor. The literature review highlighted that project management in the present era has grown into an approach that features multiple disciplines as it adopts a broader operational role for enhanced control, improved relations with clients and higher returns (Medić et al., 2013; Burke and Barron, 2014). Significant leadership challenges are faced by the construction industry, such as those that are workforce-related, and as construction projects necessitate team effort, the leadership must ensure a substantial impact on the efficient and effective nature of such work, focusing on establishing direction, aligning personnel, motivating and inspiring. While it can be said that leadership is pertinent in all fields, the characteristics of the construction process and its projects mean that leadership is vital (Toor and Ofori, 2008; Sickinger-Nagorni and Schwanke, 2016). Construction projects are invariably high cost and demanding from a technical perspective, while the project teams are diverse and large in size. The process is typically lengthy and entails a considerable number of tasks that are distinct and interrelated. Since construction products have an influence on socio-economic development in the long term, unsatisfactory project performance can result in extreme and negative impacts on the desired successful outcomes. Therefore, in the construction sector, there is an acute requirement for effective leadership, which represents one of the primary solutions to the challenges that manifest in construction projects (Skipper and Bell, 2006; Röyttä, 2016).

Table 5.20 presents the participants' additional comments for the construction project leadership critical success factor.

Table 5.20: Additional construction project leadership components identified

Comments	Frequency	Percent
Emphasise motivation and team building to allow different members to collaborate	3	18.75%
Conduct a study for the project with the team and the stakeholders during the planning phase to comprehend project requirements	3	18.75%
The leadership must acquire complete awareness of the project's requirements	4	25%
Anticipate change and address it effectively	1	6.25%
Build relationships	1	6.25%
Assure commitment from the team and stakeholders and senior management	1	6.25%
Understand how to prioritise and [the] goals, objectives and requirements	2	12.5%
Manage conflicts during the project and devise resolutions	1	6.25%
Total	16	100%

Table 5.20 presents eight comments from the participants. '*The leadership must acquire complete awareness of the project's requirements*' was mentioned four times, which indicates its importance to the project managers. Hoyle (2018) reminded that leadership guides the direction of the organisation, and ensures that products and services of an acceptable quality are consistently provided, despite the shifting environment. Regarding '*emphasise motivation and team building to allow different members to collaborate*', as cited by three of the quality management survey

respondents, Abuhav (2017) believed that awareness of the QMS enhances both the motivation and the loyalty of the employees in terms of (i) the organisational context, (ii) the organisation's quality policy and objectives, and (iii) the implications of the actions of those carrying out activities in the QMS. Also forwarded by three project managers was the '*conduct a study for the project with the team and the stakeholders during the planning phase to comprehend project requirements*' component, with Rumane (2018) pointing out that the conceptual phase includes (i) identifying the needs of the client and establishing the primary goals, (ii) conducting a feasibility study based on the client's objectives, and (iii) identifying the project team. Another factor component raised by two of the quality management survey participants was '*understand how to prioritise and [the] goals, objectives and requirements*', with Hoyle (2018) suggesting that leaders communicate and implement a strategy for achieving the organisational goals and objectives, and then employ performance measures that promote behaviour that echoes these goals and objectives. The remaining comments were only stated once.

In summary, the following list of components related to the leadership critical success factor were identified as critical according to the responses of the project managers:

- Establish a vision for the project
- Ensure commitment to the role
- Equip employees
- Establish a pathway for the project
- Create trust with employees
- Ensure responsibility to project partners
- Ensure commitment to policy
- Identify challenging targets
- Ensure the efficient use of resources
- The leadership must acquire complete awareness of the project's requirements
- Emphasise motivation and team building to allow different members to collaborate
- Conduct a study for the project with the team and the stakeholders during the planning phase to comprehend project requirements
- Understand how to prioritise and the goals, objectives and requirements

5.6.2.7 Breakdown of the process approach critical success factor

The respondents were asked to what extent they agreed or disagreed with the statement: *to promote a process approach during the lifecycle of the construction project, it is important that I/ my organisation undertake the following activities*. Eleven components were presented, which emerged from the literature review as supporting the effective implementation of ISO 9001 in construction projects, and space was permitted for the respondents to add additional comments/ factors.

Table 5.21 and Figure 5.9 present the respondents' responses ranked by importance of the process approach components based on what they believed is pertinent to support effective implementation of the ISO 9001 QMS in UK construction projects and to deliver a successful project.

Table 5.21: The importance of the process approach components

Factor components		Strongly agree	Agree	Neither	Disagree	Strongly disagree	Mean	Std. deviation	Rank	Description
Manage activities as processes	N	64	45	7	5	0	4.39	.779	1	Strongly agree
	%	51.6%	36.3%	5.6%	4%	0%				
Reduce activities that add no value	N	51	58	5	7	0	4.26	.793	2	Strongly agree
	%	41.1%	46.8%	4%	5.6%	0%				
Reduce processes that add no value	N	1	35	5	73	7	2.59	.997	8	Disagree
	%	0.8%	28.2%	4%	58.9%	5.6%				
Conduct audits of processes	N	10	57	14	37	3	3.28	1.066	7	Neither
	%	8.1%	46%	11.3%	29.8%	2.4%				
Improve processes to prevent nonconformities	N	0	38	8	60	15	2.57	1.063	9	Disagree
	%	0%	30.6%	6.5%	48.4%	12.1%				
Determine the knowledge necessary for the operation of processes	N	0	36	8	64	13	2.55	1.032	10	Disagree
	%	0%	29%	6.5%	51.6%	10.5%				
Maintain the knowledge necessary	N	3	26	9	78	5	2.54	.958	11	Disagree
	%	2.4%	21%	7.3%	62.9%	4%				

for the operation of processes										
Take action to address risk	N	39	63	10	8	1	4.08	.862	4	Agree
	%	31.5%	50.8%	8.1%	6.5%	0.8%				
Take action to exploit opportunity	N	45	54	13	8	1	4.11	.902	3	Agree
	%	36.3%	43.5%	10.5%	6.5%	0.8%				
Gauge the feasibility of activities	N	27	64	16	12	1	4.02	1.960	6	Agree
	%	21.8%	51.6%	12.9%	9.7%	0.8%				
Determine links between activities	N	47	47	15	9	3	4.04	1.020	5	Agree
	%	37.9%	37.9%	12.1%	7.3%	2.4%				
F6 Weighted Mean							3.4944			
F6 Std. Deviation								.36076		

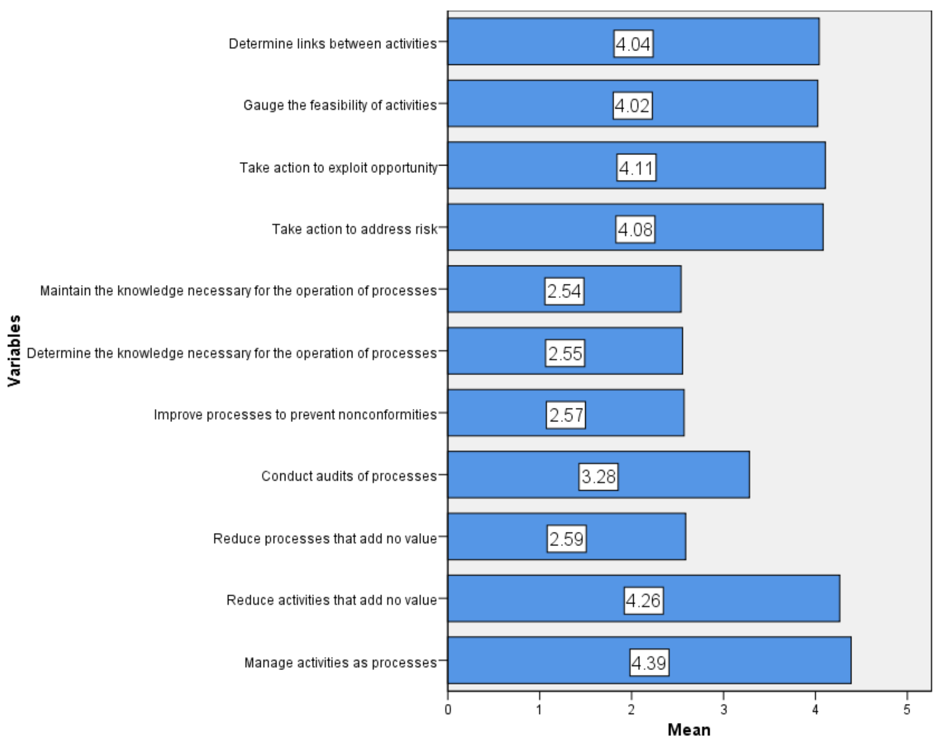

Figure 5.9: The importance of the process approach critical success factor

From Table 5.21 and Figure 5.9 above, the highest average response was for the 'manage activities as processes' component (mean: 4.39, standard deviation: .779). This is also confirmed by the literature, where Sickinger-Nagorni and Schwanke (2016) reported that the process approach QMP provides clarity in terms of how activities are converted into processes that are interlinked to enable the achievement of particular goals (see section 3.4.2.4), while teams involve to enhance efficiencies and address those processes that do not lead towards the established goals. This is followed by 'reduce activities that add no value', ranked second and also strongly agreed upon by the project managers (mean: 4.26, standard deviation: .793).

In terms of risk in the project, through their publication exploring TQM and Six Sigma, Dumitrascu and Nedelcu (2012) reminded that every project features a myriad of process that must be concluded prior to the project proceeding to the subsequent stage (see section 3.4.2.4), with the QMS being assisted by measures to manage risk. Fonseca and Domingues (2017b) asserted that those risks presenting a threat to the organisation must be identified and addressed through action, such as applying SWOT analysis and a risk matrix to assess the operational risk. The project managers agreed with the need to 'take action to address risk', ranked fourth in terms of the importance (mean: 4.08, standard deviation: .862). Conversely, Dumitrascu and Nedelcu (2012) and Fonseca and Domingues (2017a) claimed that opportunities will also emerge (see section 3.4.2.4), and thus action should be taken to exploit these, which was confirmed by the quality management survey respondents agreeing with the 'take action to exploit opportunity' component (mean: 4.11, standard deviation: .902), ranked third. Fonseca and Domingues (2017a) suggested that risk-based thinking is necessary at both the organisational and the process levels to identify risks and opportunities, and since these may impact on the QMS and its specified outcomes, the management of such risks and opportunities is an important component of the process approach.

Regarding 'determine links between activities', this was agreed upon and ranked fifth in importance (mean: 4.04, standard deviation: 1.020). In her paper on risk-based thinking based in the ISO 9001:2015 standard, Chiarini (2017) interviewed 18 experts from organisations that provide internationally recognised certification, as well as 10 QMS managers from SMEs, followed by a survey of 144 quality managers from European SMEs. Chiarini (2017) asserted the importance to the QMS of establishing how activities are linked (see section 3.4.2.4). Dumitrascu and Nedelcu (2012) discussed the feasibility of activities in terms of the risks, opportunities and triggers (see section 3.4.2.4), by respectively exploring what might go wrong, how activities could be better conducted and what warning signs might signal an issue. In this context, the quality management survey respondents agreed with the 'gauge the feasibility of activities' component (mean: 4.02, standard deviation: 1.960).

The lowest average was found to be the 'maintain the knowledge necessary for the operation of processes' component (mean: 2.54, standard deviation: .958). This is surprising, as the literature emphasised the importance of this component for the development of operations and the continuity of operational development (Jabnoun and Sedrani, 2005). This component was followed by 'determine the knowledge necessary for the operation of processes' (mean: 2.55, standard deviation: 1.032), 'improve processes to prevent nonconformities' (mean: 2.57, standard deviation: 1.063), and 'reduce processes that add no value' (mean: 2.59, standard deviation: .9997) as the next lowest-rated identified components, where the respondents disagreed with each. This means that the rate of importance of these four components was weak among the respondents, and thus these will be excluded from the final list of critical success factor components.

The weighted average of the process approach critical success factor is 3.4944 with a standard deviation of .36076, which indicates that the importance of the process approach components is agreed as a general trend based on the results from the Likert scale (see Table 5.1), as 3.4944 lies in the high-level interval range.

Therefore, the project managers accepted the process approach as a critical success factor to support effective implementation of the ISO 9001 QMS in UK construction projects, while rejecting four of the components of this factor. The literature review found that the results in the context of consistency and predictability can be more efficiently and effectively realised when tasks are comprehended and perceived as connected processes that behave as a system that is coherent (Wilson and Campbell, 2016). Processes are dynamic because they result in outcomes. Therefore, projects/ processes should be effectively and efficiently structured to facilitate the achievement of certain objectives (Sickinger-Nagorni and Schwanke, 2016). The ISO 9001 QMS is developed through the linking of interconnected processes to enable the delivery of the organisational objectives, namely, the stakeholders' satisfaction (Sitnikov and Bocean, 2015). This facilitates in allowing a system to be structured in order to effectively and efficiently realise the organisation's objectives and to comprehend the interdependencies between the system's processes, while providing increased awareness of the roles and responsibilities that are necessary to enable the achievement of common objectives, and thus to minimise cross-functional obstacles, while identifying and describing how particular activities should be carried out (Fonseca and Domingues, 2017a).

Table 5.22 presents the participants' additional comments for the process approach critical success factor.

Table 5.22: Additional process approach components identified

Comments	Frequency	Percent
Manage and monitor every process and control, measure the results, and report	3	25%
Control the cost, issues and scope; manage the benefits, risks, and time	1	8.33%
Ensure the appropriate methodologies, resources, personnel and tools are available for each planning process	2	16.67%
Assure that all those involved in the project have an appropriate understanding of the process level	2	16.67%
Evaluate and improve the processes is a constant, systematic and repetitive procedure	3	25%
Determine the key processes and standards for them	1	8.33%
Total	12	100%

Table 5.22 shows six comments from the participants. Three of the quality management survey respondents reported the need to '*manage and monitor every process and control, measure the results, and report*'. Rumane (2018) described that once the planning stage has been completed and the project has begun, progress must be monitored and controlled to assure that the project's aims and objectives are being realised, which helps to identify any issues that arise and to then take measures to overcome these. He explained that monitoring involves the collection, recording and reporting of all pertinent information associated with the project's performance that the project

manager should be aware of. The next factor forwarded by three of the project manager respondents to the quality management survey was '*evaluate and improve the processes is a constant, systematic and repetitive procedure*'. In this context, Abuhav (2017) cited the importance of conducting regular internal audits to establish how effectively the requirements of the QMS are being fulfilled, with the results revealing issues to address and opportunities to improve, as well as whether the QMS is being maintained and implemented effectively. After that, two of the quality management survey respondents highlighted the need to '*ensure the appropriate methodologies, resources, personnel and tools are available for each planning process*'. Hoyle (2018) asserted that effective planning involves determining which resources and personnel are required to complete a project or fulfil a service, where the identified processes must meet the specified requirements. The next component forwarded by two project managers was '*assure that all those involved in the project have an appropriate understanding of the process level*', with Chiocchio et al. (2011) reporting on the effectiveness of team building in terms of addressing process-related issues, alongside establishing more refined goals and more clearly defined roles. The other comments were mentioned only once.

The following is a list of components of the process approach critical success factor according to the responses of the project managers, supplemented by additional components of importance they added, where the repeated comments have been selected, and certain components have been deleted because of their low rating according to the Likert scale responses:

- Manage activities as processes
- Reduce activities that add no value
- Take action to exploit the opportunity
- Take action to address risk
- Determine links between activities
- Gauge the feasibility of activities
- Manage and monitor every process and control, measure the results, and report
- Evaluate and improve the processes is a constant, systematic and repetitive procedure
- Ensure the appropriate methodologies, resources, personnel and tools are available for each planning process

- Assure that all those involved in the project have an appropriate understanding of the process level

5.6.2.8 Breakdown of the manage relationships with stakeholders' critical success factor

The respondents were asked to what extent they agreed or disagreed with the statement: *to manage relationships with stakeholders for effective ISO 9001 implementation in UK construction projects, it is important that I/ my organisation undertake the following activities*. Nine components were presented, which emerged from the literature review as supporting the effective implementation of ISO 9001 in construction projects, and space was permitted for the respondents to add additional comments/ factors.

Table 5.23 and Figure 5.10 present the respondents' responses ranked by importance of the relationship management components based on what they believed is pertinent to support effective implementation of the ISO 9001 QMS in UK construction projects and to deliver a successful project.

Table 5.23: The importance of the relationship management components

Factor components		Strongly agree	Agree	Neither	Disagree	Strongly disagree	Mean	Std. deviation	Rank	Description
Share information with stakeholders	N	71	34	6	8	2	4.36	.965	1	Strongly agree
	%	57.3 %	27.4%	4.8%	6.5%	1.6%				
Share plans with stakeholders	N	52	52	9	7	1	4.21	.878	2	Strongly agree
	%	41.9%	41.9%	7.3%	5.6%	0.8%				
Share resources with stakeholders	N	0	34	7	68	12	2.52	1.009	8	Disagree
	%	0%	27.4%	5.6%	54.8%	9.7%				
Share expertise with stakeholders	N	0	40	6	54	21	2.54	1.126	7	Disagree
	%	0%	32.3%	4.8%	43.5%	16.9%				
Cooperate in the development of activities	N	43	56	11	10	1	4.07	.923	3	Agree
	%	34.7%	45.2%	8.9%	8.1%	0.8%				

Establish effective intra-project-partner cooperation	N	36	62	11	10	2	3.99	.935	5	Agree
	%	29%	50%	8.9%	8.1%	1.6%				
Manage effective intra-project-partner cooperation	N	0	30	4	85	2	2.51	.886	9	Disagree
	%	0%	24.2%	3.2%	68.5%	1.6%				
Establish short-term relationships	N	39	59	9	13	1	4.01	.953	4	Agree
	%	31.5%	47.6%	7.3%	10.5%	0.8%				
Establish long-term relationships	N	40	57	10	10	4	3.98	1.025	6	Agree
	%	32.3%	46.0%	8.1%	8.1%	3.2%				
F7 Weighted Mean							3.5776			
F7 Std. Deviation								.48169		

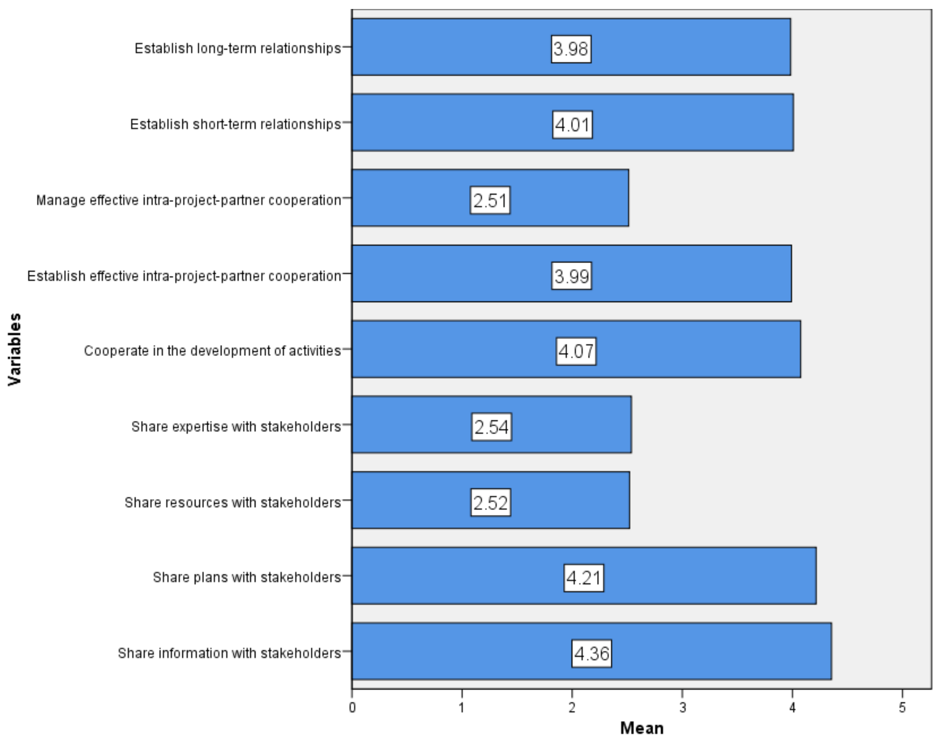

Figure 5.10: The importance of the relationship management critical success factor

From Table 5.23 and Figure 5.10 above, the highest average response was for the 'share information with stakeholders' component (mean: 4.36, standard deviation: .965). This view was supported by the literature, where Sickinger-Nagorni and Schwanke (2016) underscored that relationship management places its focus on the relationships with the internal and external stakeholders to improve communication, understanding, and trust (see section 3.4.2.7). This component was followed by 'share plans with stakeholders' (mean: 4.21, standard deviation: .878) as the next highest-rated identified component, where the participants also strongly agreed. Hoyle (2018) asserted the need to disseminate plans with stakeholders in order to gather their views and feedback.

'Cooperate in the development of activities' was agreed upon by the project managers, ranked third in terms of its importance (mean: 4.07, standard deviation: .923), and as stated in Hola's (2015) paper that identified and evaluated the processes in a construction organisation. In his chapter exploring competence education and training for quality, Moracanin (2012) concluded on the need to establish improved cooperation with business organisations and academic institutions (see section 3.4.2.7). The project managers indicated their agreement with this through the 'establish effective intra-project-partner cooperation' component, which was ranked fifth out of the nine components included in the relationship management part of the quality management survey (mean: 3.99, standard deviation: .935). Establishing short-term relationships (mean: 4.01, standard deviation: .953) and long-term relationships (mean: 3.98, standard deviation: 1.025) were also agreed upon by the quality management survey respondents, being ranked fourth and sixth, respectively. In the context of both these components, Mansour et al. (2019) found through their quality management survey that the majority of managers either agreed or strongly agreed with the importance of developing robust relations with others (see section 3.4.2.7).

The lowest average was found to be the 'manage effective intra-project-partner cooperation' component (mean: 2.51, standard deviation: .886), This is surprising, because it would seem to be an important component in terms of relationship management with partners and has been supported in the literature through Manders et al. (2016). This component was followed by 'share resources with stakeholders' (mean: 2.52, standard deviation: 1.009), and 'share expertise with stakeholders' (mean: 2.54, standard deviation: 1.126) as the next lowest-rated identified components, where the participants disagreed with each. This means that the rate of importance of these three components was weak among the respondents, and thus these will be excluded from the final list of critical success factor components.

The weighted average of the relationship management critical success factor is 3.5776 with a standard deviation of .48169, which indicates that the importance of managing relationships with stakeholder components is agreed upon as a general trend based on the results from the Likert scale (see Table 5.1), as 3.5776 lies in the high-level interval range.

Therefore, the project managers accepted relationship management as a critical success factor to support effective implementation of the ISO 9001 QMS in UK construction projects, while rejecting three of the components of this factor. This view was supported by the literature, where it was found that a significant concern emerging in the field of construction project management is recognising and managing the stakeholders of the project, since these represent a considerable form of uncertainty in the context of the construction project (Skipper and Bell, 2006; Atkin and Skitmore, 2008). The primary elements impacting on the process of managing stakeholders are recruiting a highly competent project manager, evaluating alternative solutions in a transparent manner, ensuring that the project management–stakeholder communication is effective, establishing agreed project goals and objectives, and investigating the stakeholders' needs and expectation. As a discipline, construction project management places its focuses on the planning process and managing the diverse range of activities necessary to successfully complete the construction project (Olander and Landin, 2005; Aized, 2012). Stakeholders may have differing degrees and forms of interests and investments in the projects they become involved in, while in the current era virtually every project is conducted in a context whereby the stakeholders play an important role in the project's completion. Projects are frequently sensitive to the decisions and actions stakeholders take. Therefore, in order to secure a successful outcome, the project management team must ensure that the stakeholders are identified, their expectations and requirements are determined, and that their influence is managed in terms of the project's requirements (Enshassi et al., 2009; Manders and de Vries, 2012).

Table 5.24 presents the participants' additional comments for the managing relationships with stakeholder critical success factor.

Table 5.24: Additional managing relationships with stakeholders' components identified

Comments	Frequency	Percent
Focus on written and oral communication, and written agreements	1	8.33%
Ensure that all parties comprehend the overarching project aims	2	16.67%
Engage stakeholders effectively and frequently	3	25%
Formulate strategies for stakeholder management	1	8.33%
Promote good stakeholder relationships	2	16.67%
Explore the influence of stakeholders and analyse the collaborations and conflicts	1	8.33%
Assess the stakeholders' behaviour and needs	2	16.67%
Total	12	100%

Table 5.24 presents seven comments from the participants. '*Engage stakeholders effectively and frequently*' was mentioned three times. Hoyle (2018) described stakeholders in the business context as those who contribute to the organisation through commitment and/ or resources and create benefit, while expecting something in return. Therefore, stakeholders are clearly an important component of any organisation, and thus the project managers' assertion that they should be engaged with effectively and often. Two of the project managers cited the need to '*ensure that all parties comprehend the overarching project aims*', which again links back to Sickinger-Nagorni and Schwanke's (2016) assertion of the need to promote effective communication with both internal and external stakeholders, to assure the project's success and the ongoing well-being of the organisation. The need to '*promote good stakeholder relationships*' was raised by two of the quality management survey respondents, with Mansour et al. (2019) concurring with this view through the results of their questionnaire survey. The final factor component to emerge under the relationship management critical success factor was '*assess the stakeholders' behaviour and needs*', as highlighted by two of the quality management survey respondents. This links to Heravi et al. (2015) and their study that measured the degree of stakeholder involvement during construction projects' project planning processes, where they found that despite the importance of determining the stakeholders' needs, many organisations do not fully commit to such assessment. The remainder of the comments were listed only once.

In summary, the following list of components related to the relationship management critical success factor were identified as critical according to the responses of the project managers:

- Share information with stakeholders
- Share plans with stakeholders
- Cooperate in the development of activities
- Establish short-term relationships
- Establish effective intra-project-partner cooperation
- Establish long-term relationships
- Engage stakeholders effectively and frequently
- Ensure that all parties comprehend the overarching project aims
- Promote good stakeholder relationships
- Assess the stakeholders' behaviour and needs

5.6.2.9 Breakdown of team members' skills and training critical success factor

The respondents were asked to what extent they agreed or disagreed with the statement: *in relation to skills and training, it is important that I/ my organisation undertake the following activities*. Seven components were presented, which emerged from the literature review as supporting the effective implementation of ISO 9001 in construction projects, with space permitted for the respondents to add additional comments/ factors.

Table 5.25 and Figure 5.11 present the respondents' responses ranked by importance of the skills and training components based on what they believed is pertinent to support effective implementation of the ISO 9001 QMS in UK construction projects and to deliver a successful project.

Table 5.25: The importance of the skills and training components

Factor components		Strongly agree	Agree	Neither	Disagree	Strongly disagree	Mean	Std. deviation	Rank	Description
Train personnel in terms of quality	N	0	14	3	91	13	2.15	.760	7	Disagree
	%	0%	11.3 %	2.4%	73.4 %	10.5%				
Share knowledge	N	4	63	4	47	3	3.15	1.062	1	Agree
	%	3.2%	50.8%	3.2%	37.9%	2.4%				
Enable learning	N	0	35	8	63	15	2.52	1.042	4	Disagree
	%	0%	28.2%	6.5%	50.8%	12.1%				
Share the quality aims and characteristics	N	0	68	1	48	4	3.10	1.044	2	Agree
	%	0%	54.8%	0.8%	38.7%	3.2%				
Teach the quality aims and characteristics	N	0	27	2	72	20	2.30	.997	5	Disagree
	%	0%	21.8%	1.6%	58.1%	16.1%				
Manage communication	N	0	39	5	68	9	2.61	1.020	3	Neither
	%	0%	31.5%	4%	54.8%	7.3%				
Improve communication	N	0	23	6	71	21	2.26	.962	6	Disagree
	%	0%	18.5 %	4.8%	57.3%	16.9%				
F8 Weighted Mean							2.5832			
F8 Std. Deviation								.49301		

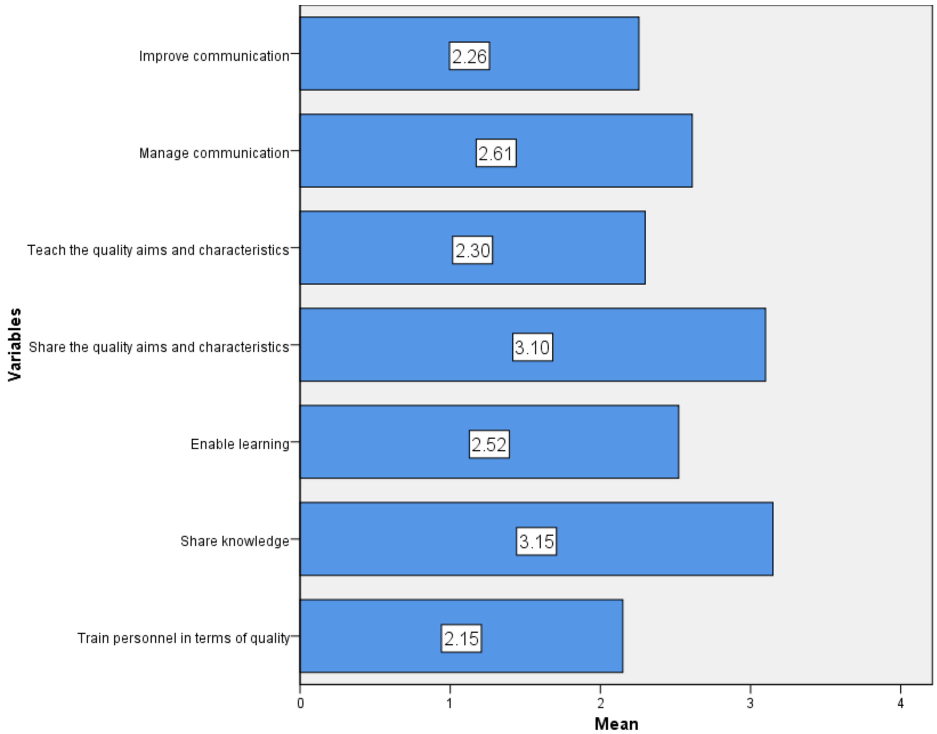

Figure 5.11: The importance of the skills and training critical success factor

From Table 5.25 and Figure 5.11 above, the highest average response was for the 'share knowledge' component, (mean: 3.15, standard deviation: 1.062). This is also confirmed by the literature, where Shaari et al. (2015) explored the need to ensure formal and informal design communication, as well as formal and informal construction communication, finding importance to relative degrees in terms of the budget, schedule and quality performance. This component was followed by 'share the quality aims and characteristics' (mean: 3.10, standard deviation: 1.044) as the next highest-rated component, where the participants agreed with both. In Chiarini's (2017) study, quality managers asserted that the absence of, or insufficient training, leads to poor quality products and services, and thus dissatisfied clients, while claiming that workers need to develop a sense of how such poor quality products and services result in low levels of client satisfaction, with this issue exacerbated when temporary staff are utilised.

The lowest average and ranked seventh was found to be the 'train personnel in terms of quality' component (mean: 2.15, standard deviation: .760), in contrast to the literature, where Willar et al.'s (2015; see section 3.9) research concluded on the need for the Indonesian construction industry to ensure the increased implementation of robust QMSs in order to improve the organisational performance and generate enhanced opportunities to expand into the international domain. This component was followed by 'improve communication' (mean: 2.26, standard deviation: .962) ranked sixth, and then 'teach the quality aims and characteristics' (mean: 2.30, standard deviation: .997) and 'enable learning' (mean: 2.52, standard deviation: 1.042), where the participants disagreed with all three. This means that the rate of importance of these four components was weak among the respondents, and thus these will be excluded from the final list of critical success factor components.

Finally, the 'manage communication' component was neither agreed nor disagreed upon by the project managers who responded to the quality management survey (mean: 2.61, standard deviation: 1.020), while Shaari et al. (2015) found communication to have varying importance regarding the performance of the budget, schedule, and quality outcomes.

The weighted average of the skills and training critical success factor is 2.5832, with a standard deviation of .49301, which indicates that the importance of the skills and training components is disagreed upon as a general trend based on the results from the Likert scale (see Table 5.1), as 2.5832 lies in the low-level interval range.

This means that the participants rejected skills and training as a critical success factor to support effective implementation of the ISO 9001 QMS in UK construction projects, and thus this will be considered for exclusion from the final list of critical success factors. This is contrary to the literature, where it was revealed that the employees from all tiers of a project should receive the appropriate level and type of training to promote their general knowledge and understanding regarding the concepts of quality management. A training and education programme should be developed and implemented regularly to enable employees to manage issues that are becoming increasingly complex (Willar et al., 2015; Chiarini, 2017). In the absence of training, it is difficult to resolve challenging issues, while the lack of education means that attitudinal and behavioural change will not occur. The focus of the training programme should be placed on supporting managers to achieve improvements, while it must be understood that some employees may not have received and developed the required levels of education. Although the training programme structure may involve the refreshing of elementary educational skills to a certain extent, continued education and self-development must be promoted. Training implies the acquisition of certain knowledge or skills, with training programmes attempting to facilitate employees in terms of performing certain activities or roles. Education is more generalised and aims to furnish employees with broad knowledge that is applicable in a range of scenarios (Chiarini, 2017; Shaari et al., 2015).

Table 5.26 presents the participants' additional comments for the skills and training critical success factor.

Table 5.26: Additional skills and training components identified

Comments	Frequency	Percent
Identify training needs and the optimum training methods	1	8.33%
When hiring a project team, focus on their competence, professional knowledge, qualifications, and experience, etc.	1	8.33%
Promote specific quick training and mentoring, as well as performance appraisals	1	8.33%
Comprehensively explain the project's scope to the team	2	16.67%
Clearly discuss the general rules of project management and their respective roles with the potential team	1	8.33%
Remind staff how and what they can improve on	3	25%
Offer and receive feedback regularly to improve performance	2	16.67%
Facilitate effective communication	1	8.33%
Total	12	100%

Table 5.26 shows eight comments from the participants, where '*remind staff how and what they can improve on*' and '*offer and receive feedback regularly to improve performance*' were cited by three and two respondents, respectively, which link more closely to the continuous improvement critical success factor, and the '*dissemination of internal awareness on continuous improvement*' asserted by three of the respondents (see section 5.6.2.10 below). Clearly it is important to offer feedback to the staff on their performance in terms of where they are excelling and where improvements can be made, with Abuhav (2017) reminding that employees, alongside audits and client feedback, represent valuable opportunities for improvement; however, as mentioned above, this is situated in the continuous improvement rather than the skills and training domain. Then, the

need to '*comprehensively explain the project's scope to the team*' was mentioned by two of the quality management survey respondents, which falls more appropriately under the engagement with people critical success factor, and echoes the aforementioned '*clarify work priorities and define the roles and responsibilities of the project team*' component raised by three of the quality management survey respondents (see section 5.6.2.5). In this context, Chiocchio et al. (2011) asserted that integrated teams must develop the ability to engage in effective collaboration to realise the benefits that arise such as enhanced communication and feedback. The remainder of the comments were stated only once.

The following is a list of the components of the skills and training critical success factor according to the responses of the project managers, supplemented by additional components of importance they added, where the repeated comments have been selected, and certain components have been deleted because of their low rating according to the Likert scale responses:

- Share knowledge
- Share the quality aims and characteristics
- Remind staff how and what they can improve on
- Comprehensively explain the project's scope to the team
- Offer and receive feedback regularly to improve performance

5.6.2.10 Breakdown of the continuous improvement critical success factor

The respondents were asked to what extent they agreed or disagreed with the statement: *to apply continuous improvement during the construction project lifecycle, it is important that I/ my organisation undertake the following activities*. Eleven components were presented, which emerged from the literature review as supporting the effective implementation of ISO 9001 in construction projects, while space was permitted for the respondents to add additional comments/ factors.

Table 5.27 and Figure 5.12 present the respondents' responses ranked by importance of the continuous improvement components based on what they believed is pertinent to support effective implementation of the ISO 9001 QMS in UK construction projects and to deliver a successful project.

Table 5.27: The importance of the continuous improvement components

Factor components		Strongly agree	Agree	Neither	Disagree	Strongly disagree	Mean	Std. deviation	Rank	Description
Provide resources for continuous improvement	N	72	46	2	0	1	4.55	.618	1	Strongly agree
	%	58.1 %	37.1%	1.6%	0%	0.8%				
Manage resources for continuous improvement	N	53	64	3	1	0	4.40	.584	3	Strongly agree
	%	42.7 %	51.6%	2.4%	0.8%	0%				
Provide documentation for corrective action	N	64	52	5	0	0	4.49	.579	2	Strongly agree
	%	51.6%	41.9%	4%	0%	0%				
Enable the project team to participate in improvement	N	43	73	0	3	2	4.26	.601	7	Strongly agree
	%	34.7%	58.9%	0%	2.4%	1.6%				
Conduct operational planning	N	48	63	8	1	1	4.29	.700	6	Strongly agree
	%	38.7%	50.8%	6.5%	0.8%	0.8%				
Conduct operational control	N	37	76	4	4	0	4.21	.657	8	Strongly agree
	%	29.8%	61.3%	3.2%	3.2%	0%				
Identify the requirements	N	53	56	9	3	0	4.31	.719	5	Strongly agree
	%	42.7 %	45.2%	7.3%	2.4%	0%				
Measure improvement consistently	N	52	61	3	5	0	4.32	.721	4	Strongly agree
	%	41.9%	49.2%	2.4%	4%	0%				
Analyse performance	N	39	53	10	17	2	3.91	1.057	10	Agree
	%	31.5%	42.7 %	8.1%	13.7%	1.6%				
Celebrate improvement	N	0	40	6	58	17	2.57	1.094	11	Disagree
	%	0%	32.3%	4.8%	46.8%	13.7%				
Develop a reward system	N	51	48	13	5	4	4.13	.991	9	Agree
	%	41.1%	38.7%	10.5%	4%	3.2%				
F9 Weighted Mean							4.1345			
F9 Std. Deviation								.36948		

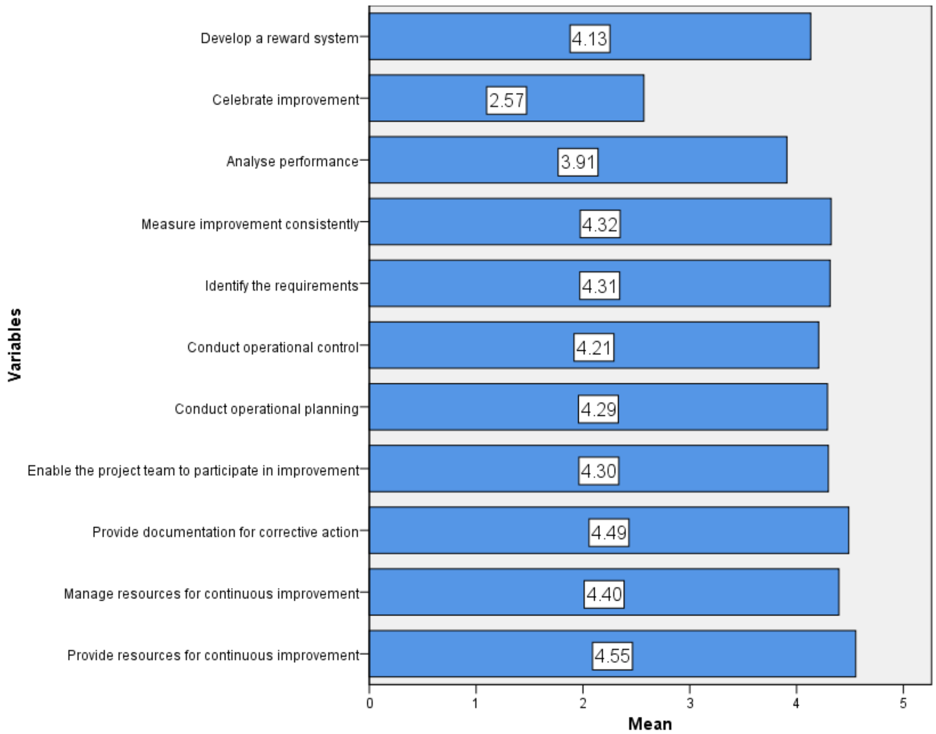

Figure 5.12: The importance of the continuous improvement critical success factor

From Table 5.27 and Figure 5.12 above, the highest average response was for the 'provide resources for continuous improvement' component (mean: 4.55, standard deviation: .618), as supported by the literature, where according to Hoyle (2018) the ISO 9001:2015 QMS has a requirement for the organisation to continually improve the QMS, and that those resources necessary for such improvement are determined and provided (see section 3.4.2.5). He provided the example of implementing changes to the QMS due to shifts in the external environment, where the provision of resources would involve the appointment of project managers in order to manage significant changes in the QMS. Once these resources have been provided, Hola (2015) proposed that they are managed by evaluating simple processes and removing errors that are observed in order to enhance continuous improvement, leading to increased levels of quality (see section 3.4.2.5). This echoes the views of the quality management survey respondents, where the project managers strongly agreed with the need to 'manage resources for continuous improvement', ranked third in importance (mean: 4.40, standard deviation: .548).

In their paper exploring the revised ISO 9001:2015 standard, Anttila and Jussila (2017) considered the issues and challenges of applying the standard from the perspectives of the implementation (see section 3.4.2.5). They criticised the new *documented information* concept and that "information [is] required to be controlled and maintained by an organization and the medium on which it is contained" as being ambiguous and difficult translate (Anttila and Jussila, 2017, p.9); for example, ISO directives state that definitions should not contain a requirement. Regarding the 'provide documentation for corrective action' component ranked second in importance, the quality management survey respondents strongly agreed (mean: 4.49, standard deviation: .579), clearly demonstrating the importance they place on developing the organisation's documentation in terms of corrective action to provide both a record and guidance for future reference.

Hoyle (2018) reported that demonstrating that the adequacy, effectiveness, and suitability of the QMS are being continually improved can be shown through the identification of opportunities for improvement (see section 3.4.2.5), which was strongly agreed upon by the quality management survey respondents through the fifth ranked 'identify the requirements' component (mean: 4.31, standard deviation: .719). In their literature review exploring the application of QMSs in construction projects, Shaari et al. (2015) found that measurement and improvement were practices that consistently featured in the seven papers they reviewed, where measurement entails data collection and analysis to promote improvement. This view on the importance of consistent measurement was echoed by the quality management survey respondents, where they strongly agreed with the need to 'measure improvement consistently' (mean: 4.32, standard deviation: .721).

The quality management survey respondents also strongly agreed with the 'enable the project team to participate in improvement' component (mean: 4.26, standard deviation: .601). Mansour el al. (2019) highlighted that improvement in the communication between senior managers and subordinates should be enabled through the exchanges of feedback in order to promote continual improvement. Mansour el al. (2019) also reported on the need to 'conduct operational planning' (see section 3.4.2.5), where this component was also strongly agreed upon by the quality management survey respondents (mean: 4.29, standard deviation: .700). In terms of operational control, the quality manager respondents in Chiarini's (2017) questionnaire survey reported that poor operational control resulted in unsatisfactory scheduling and the management of resources, with the questionnaire respondents in this research strongly agreeing with the 'conduct operational control' component (see section 3.4.2.5) (mean: 4.21, standard deviation: .657).

In their study focused on Indonesian construction companies, Willar et al. (2015) explored the analysis of performance under nine KPIs, where they found that all companies had achieved relatively high performance in terms of (i) the service quality and growth, (ii) growth in sales, (iii) profitability, (iv) the use of products that are sustainable, (v) the share of the market, and (vi) the satisfaction of employees. Despite not specifying particular KPIs, the quality management survey respondents did agree on the importance of the 'analyse performance' component to the successful implementation of the ISO 9001 QMS in UK construction projects (mean: 3.91, standard deviation: 1.057). Then, the value of developing a reward system emerged from the literature (Chiarini, 2017), and was echoed by Rumane (2018) who asserted the benefits of developing such a system to facilitate the contractor in sharing in the organisation's objectives and thus raising performance levels. In their responses to the quality management survey, the project managers agreed with the 'develop a reward system' component (mean: 4.13, standard deviation: .991).

The lowest average was found to be the 'celebrate improvement' component (mean: 2.57, standard deviation: 1.094), which the participants disagreed with. This means that the rate of importance of this component was weak among the respondents, and thus this will be excluded from the final list of critical success factor components, in contrast to Anttila and Jussila (2017), who stressed its importance for continuous improvement.

The weighted average of the continuous improvement critical success factor is 4.1345 with a standard deviation of .36948, which indicate that the importance of the continuous improvement components is agreed upon as a general trend based on the results from the Likert scale (see Table 5.1), as 4.1345 lies in the high-level interval range.

Therefore, the project managers accepted continuous improvement as a critical success factor to support effective implementation of the ISO 9001 QMS in UK construction projects, while rejecting one of the components of this factor. The ongoing improvement of all activities and operations is central to the ISO 9001 QMS, once it is recognised that effective ISO 9001 QMS implementation can be obtained by satisfying continuous improvement in the project. Consequently, the lens of focus is placed on the continuous improvement of the processes in the project, which will result in improved ISO 9001 implementation (Chiarini, 2017; Hoyle, 2018). Systems have traditionally functioned on the basis that once a project has attained a specified degree of quality, success has been achieved and therefore no additional improvement is required. Continuous improvement dictates that project management continually strives to improve via learning and the resolution of problems, as since perfection can never be achieved, the project management must continually assess their performance and implement steps for improvement (Willar et al., 2015; Anttila and Jussila, 2017).

Table 5.28 presents the participants' additional comments for the continuous improvement critical success factor.

Table 5.28: Additional continuous improvement components identified

Comments	Frequency	Percent
Listen to and manage relationships with clients and other stakeholders	2	11.11%
Offer support and the use of information technology	1	5.56%
Performance measurement at the processes level	2	11.11%
Effectively and continuously learn from project experience	4	22.22%
Ensure the adequate documentation of organisational responsibilities on the project	3	16.67%
Goals must be specific, such as reducing client complaints	1	5.56%
Processes continuous improvement teams comprise of employees nearest to the process	1	5.56%
Dissemination of internal awareness on continuous improvement	3	16.67%
Publish the results of the improvement achieved and explain the scope of the improvement programme	1	5.56%
Total	18	100%

Table 5.28 presents nine comments from the participants. The need to '*effectively and continuously learn from project experience*' was raised by four of the project managers in their additional comments. Hoyle (2018) discussed the requirements of ISO 9001:2015 for continual improvement, whereby the 2015 version does require improvement in the products/ services and the QMS, but it

does not require continual improvement in both. Therefore, there is strong emphasis at the QMS and the project level on experiential learning to inform continuous improvement. '*Dissemination of internal awareness on continuous improvement*' was asserted by three of the respondents, with Abuhav (2017) citing that continuous improvement requires the management review of elements from a range of QMS activities that are related to performance, where the outputs of this review inform the approach towards continuous improvement. It would seem that the project managers here referred to the dissemination of such reviews in order to increase the organisational awareness. Three of the project managers raised the need to '*ensure the adequate documentation of organisational responsibilities on the project'*, which is supported by Mansour et al.'s (2019) assertion of the need to systematically improve their internal and external outputs using information, and thus to clearly document the organisational responsibilities. Two of the project managers highlighted the need to '*listen to and manage relationships with clients and other stakeholders*', which links back to Abuhav (2017) and the aforementioned importance of meeting the client's needs and expectations to promote the organisation's development strategy and ensure the implementation of an effective QMS. Abuhav (2017) also discussed that the outcomes of analyses should be employed to explore opportunities for improvement, with monitoring and measurement applied to collect data that illuminate the process performance and output quality, which supports two of the project managers' assertion of the importance of conducting '*performance measurement at the processes level*'. The remainder of the comments were stated only once.

In summary, the following list of components related to the continuous improvement critical success factor were identified as critical according to the responses of the project managers:

- Provide resources for continuous improvement
- Provide documentation for corrective action
- Manage resources for continuous improvement
- Measure improvement consistently
- Identify the requirements
- Conduct operational planning
- Enable the project team to participate in improvement
- Conduct operational control

- Develop a reward system
- Analyse performance
- Effectively and continuously learn from project experience
- Dissemination of internal awareness on continuous improvement
- Ensure the adequate documentation of organisational responsibilities on the project
- Listen to and manage relationships with clients and other stakeholders
- Performance measurement at the processes level

5.7 The compare means test

A compare means test using the SPSS (v.24) software across the means of all of the critical success factors was conducted, analysed and compared, with the purpose to rank them in terms of importance to determine if they are critical success factors by using the participants' responses. Table 5.29 below shows that the highest mean value is for the 'continuous improvement' critical success factor, which the survey's project manager participants viewed as the most influential to support effective implementation of the ISO 9001 QMS in UK construction projects. On the other hand, the component 'reducing the impact of non-standardisation' was the least important for the participants according to the results and is thus placed in the category of rejection due to the low rate. Therefore, the critical success factors are included or excluded as critical success factors to implement the ISO 9001 QMS in UK construction projects according to the following:

1- The results showed that continuous improvement is one of the most important critical success factors, as it was ranked in the first position in the overall opinion of the respondents (mean: 4.1345, standard deviation: .36948; see Table 5.27).
2- The results highlighted that change management is one of the most important critical success factors, ranked second position by the respondents (mean: 4.0579, standard deviation: .49989; see Table 5.9).
3- The results revealed that evidence-based decision-making is also one of the most important critical success factors, ranked in third position by the respondents (mean: 3.9098, standard deviation: .34687; see Table 5.11).

4- The results demonstrated that client focus is an important critical success factor, ranked fourth by the respondents (mean: 3.6800, standard deviation: .48023; see Table 5.13).

5- The results showed that the leadership factor is an important critical success factor, ranked in fifth position by the respondents (mean: 3.6515, standard deviation: .43381; see Table 5.19).

6- The results highlighted that relationship management is the next most important critical success factor, ranked sixth by the respondents (mean: 3.5776, standard deviation: .48169; see Table 5.23).

7- The results revealed that the process approach is an important critical success factor, ranked in the seventh position by the respondents (mean: 3.4944, standard deviation: .36076; see Table 5.21).

8- The results demonstrated that engaging the project team is also a critical success factor, ranked eighth by the respondents (mean: 3.4333, standard deviation: .50303; see Table 5.17).

9- The results showed that skills and training is not a critical success factor, which was ranked in the ninth and penultimate position by the opinion of the respondents (mean: 2.5832, standard deviation: .49301; see Table 5.25). Consequently, ensuring the necessary skills and training for all operations and activities was not deemed to be a critical factor supporting the ISO 9001 QMS that will lead to improved implementation, and thus this will be excluded from the final list of critical success factors.

10- This study's results demonstrated that reducing the impact of non-standardisation is not an important critical success factor, ranked tenth and in the final position by the respondents (mean: 2.5758, standard deviation: .61313; see Table 5.15). With non-standardisation in all operations and activities not seen as a critical success factor for effective ISO 9001 implementation, this will also be excluded from the final list of critical success factors.

Table 5.29: The compare means test results

No.	Factor	Mean
1	Continuous improvement	4.1345
2	Evidence-based decision-making	3.9098
3	Change management	3.8595
4	Client focus	3.6800
5	Leadership	3.6515
6	Relationship management	3.5776
7	The process approach	3.4944
8	Engage the project team	3.4333
9	Skills and training	2.5832
10	Reduce the impact of non-standardisation	2.5758

5.8 The Kendall's W test

To identify an overall trend of agreement between the participants for each of the critical success factors for effective ISO 9001 QMS implementation in UK construction projects, the study utilised Kendall's W test to assess the coefficient of concordance to determine the measurement of agreement within the sample, whereby the sum of the ranks is found for each variable, which range between 0 (no agreement) and 1 (agreement). The calculated Kendall's coefficients of concordance for each critical success factor are presented in Table 5.30 below.

The null hypothesis H0 supposes that there is no degree of agreement among the participants for the prioritisation of importance of the critical success factors (p-value $\geq \alpha = 0.05$, where α is the level of significance).

The alternative hypothesis H1 supposes that there is an overall trend of agreement among the participants for the prioritisation of importance of the critical success factors (p-value $< \alpha = 0.05$).

Since the p-value is less than α, the null hypothesis, H0, is rejected and the alternative hypothesis, H1, is accepted. Consequently, a significator of agreement between the different participants can be concluded, since the Kendall coefficient of concordance can be utilised to determine the extent that a group provide a common ranking about a set of variables (Legendre, 2005). So, the participants were consistent in their perceptions of the importance of the critical success factors.

Table 5.30: The Kendall's W test

No.	Factor	Kendall's W	Chi-Square	P-value	Decision
1	Continuous improvement	.221	293.932	.000	Reject H0
2	Change management	.219	105.802	.000	Reject H0
3	Evidence-based decision-making	.248	330.084	.000	Reject H0
4	Client focus	.390	330.062	.000	Reject H0
5	Leadership	.312	453.317	.000	Reject H0
6	Relationship management	.431	469.739	.000	Reject H0
7	The process approach	.393	523.234	.000	Reject H0
8	Engage the project team	.411	347.924	.000	Reject H0
9	Skills and training	.402	110.423	.000	Reject H0
10	Reduce the impact of non-standardisation	.402	57.584	.000	Reject H0
ALL		.364	396.803	.000	Reject H0

5.9 The Kruskal–Wallis test

The Kruskal–Wallis test is utilised to enable comparison of the means of the ranks of two or more groups of samples, which allows examination to identify any differences in the respondents' perspectives in terms of the level of the respective critical success factors for effective ISO 9001 QMS implementation in UK construction projects.

The null hypothesis H0 supposes that the population medians are equal, that is, the sample is taken from identical populations/ the same population (p-value $\geq \alpha = 0.05$, where α is the level of significance).

The alternative hypothesis H1 supposes that the population medians are not equal (i.e. the sample is not taken from identical populations/ the same population) and at least two of the populations are different (p-value $< \alpha = 0.05$).

The Kruskal–Wallis results are shown in Table 5.31 below, where it can be seen that most of the p-values for each critical success factor are smaller than $\alpha = 0.05$. Therefore, there are differences between the participants' opinions regarding their responses to all the critical success factors, and thus the null hypothesis, H0, is rejected and the alternative hypothesis, H1, is accepted. Consequently, we can conclude that the participants come from different backgrounds, which has an effect on the respondents to a degree.

Table 5.31: The Kruskal–Wallis test

No.	Factor	Kruskal–Wallis value	P-value
1	Continuous improvement	8.730	.003
2	Change management	1.048	.306
3	Evidence-based decision-making	5.650	.017
4	Client focus	6.238	.013
5	Leadership	5.628	.018
6	Relationship management	8.089	.004
7	The process approach	6.836	.009
8	Engage the project team	5.350	.021
9	Skills and training	0.155	.694
10	Reduce the impact of non-standardisation	4.055	.044
ALL		5.8294	.0464

5.10 The Spearman correlation coefficient test

Spearman's correlation coefficient allows the measurement and determination of the intensity and the direction of the association and relation that exist between two variables, where if one variable's value increases, so does that of the other variable; or, if one variable's value increases, the other decreases. In the present research, the relationship between each main critical success factor and the effective implementation of the ISO 9001 QMS in UK construction projects is determined to assess the extent to which the ten critical success factors support this.

The results are shown in Table 5.32 below, where the correlation between each main critical success factor influencing effective implementation of the ISO 9001 QMS can be seen. For all the critical success factors except evidence-based decision-making, the p-value is 0.000, and thus smaller than $\alpha = 0.05$ (where α is the level of significance). Therefore, a significant relationship between each main critical success factor influencing the effective implementation of the ISO 9001 QMS in UK construction projects can be concluded. On the other hand, since the p-value of .307 for evidence-based decision-making is greater than the level of significance, there is no significant relationship between the influence of making decisions based on the evidence and effective implementation of the ISO 9001 QMS in UK construction projects, and thus this is excluded as a critical success factor.

Table 5.32: The Spearman correlation coefficient test

No.	Factor	Spearman correlation coefficient	P-value
1	Continuous improvement	.358	.000
2	Change management	.470	.000
3	Evidence-based decision-making	.094	.307
4	Client focus	.390	.000
5	Leadership	.601	.000
6	Relationship management	.303	.000
7	The process approach	.460	.000
8	Engage the project team	.408	.000
9	Skills and training	.279	.002
10	Reduce the impact of non-standardisation	.351	.000

5.11 Critical success factors to support effective implementation of the ISO 9001 QMS in UK construction projects based on the quality management survey and the literature review

This study's primary aim is to identify the critical success factors that support the effective implementation of the ISO 9001 QMS in UK construction projects in order to improve the project's performance. Through an in-depth review of the literature, 10 critical success factors were extracted with the associated components (n=82), and tested through the quality management survey distributed to UK construction project managers. The construction companies conveyed the importance of having ISO 9001 quality certification and applying its standards for excellence, with 94% (n=117) of the project managers reporting that their organisations have such certification (see Table 5.3) and also apply it in practice (see Table 5.5). The responses of these 117 project managers to the Likert scale statements in the quality management survey were then analysed, with Table 5.33 presenting a summary of the weighted means and standard deviations of each critical success factor, as well as the factor components that were accepted (agree/strongly agree), neutral (neither agree nor disagree), and rejected (disagree/strongly disagree), and new factor components asserted by two or more of the project managers.

Table 5.33 Summary of the Likert scale analysis

Critical success factor	Weighted Mean	Std. Deviation	Factor components			
			Accepted	Neutral	Rejected	New
Change management	4.0579	.49989	4	-	-	4
Evidence-based decision-making	3.9098	.34687	10	-	1	3
Client focus	3.6800	.48023	5	-	2	3
Non-standardisation	2.5758	.61313	1	-	2	2
Engagement of people	3.4333	.50303	4	-	3	5
Leadership	3.6515	.43381	9	-	3	4
Process approach	3.4944	.36076	6	1	4	4
Relationship management	3.5776	.48169	6	-	3	4
Skills and training	2.5832	.49301	2	1	4	3
Continuous improvement	4.1345	.36948	10	-	1	5

After completing the analysis of the Likert scale results, a number of additional tests were conducted to validate the findings. First, the compare means test was applied to rank the critical success factors in terms of their perceived importance by the participants (based on the mean value for each), where it was found that two critical success factors were deemed to be the least important, namely skills and training and non-standardisation at 2.5832 and 2.5758, respectively (see Table 5.33). Next, the Kendall's W test was conducted to determine the level of overall agreement between the participants in terms of each critical success factor, where hypothesis H1 was accepted, showing a trend of agreement regarding the importance of the critical success factors (average values: Kendal's W=.364, Chi-square=396.803, P=.000; see Table 5.30). After that, the Kruskal–Wallis test was applied to compare the means and examine whether the sample was taken from the same population (H0) or different populations (H1), where H0 was rejected and H1 accepted, thus confirming that the participants came from different backgrounds (average values: Kruskal–Wallis: 5.8294, P=.0464; see Table 5.31), which would impact on their responses to a degree. Finally, the Spearman correlation coefficient test was conducted to measure and determine the direction and strength of the association and relationship between each variable (the critical success factors) and the effective implementation of the ISO 9001 QMS in UK construction projects, where all the critical success factors were found to have a significant relationship with effective implementation of the ISO 9001 QMS in UK construction projects (P=.000–.002), except for evidence-based decision-making (P=.307) (see Table 5.32).

Table 5.34 below presents the findings of the research at the conclusion of Stage 2 (Investigation), where seven critical success factors and their factor component are confirmed, and three (evidence-based decision-making, non-standardisation and skills and training) are provisionally rejected.

Table 5.34: Determining analysis of the critical success factors to support effective implementation of the ISO 9001 QMS in UK construction projects

No.	Name	Component	Literature review	Survey	Compare means test	Kendall's W test	Kruskal–Wallis test	Spearman correlation coefficient test	Critical success factor
1	Change Management	Determine the needs and expectations of stakeholders	√	√	√	√	√	√	√
		Plan for change	√	√	√	√	√	√	√
		Monitor the needs and expectations of stakeholders	√	√	√	√	√	√	√
		Promote continual improvement	√	√	√	√	√	√	√
		Educate clients and other stakeholders on the negative outcomes of unnecessary change		√	√	√	√	√	√
		Predict the project environment and create contingency plans		√	√	√	√	√	√
		Anticipate change and address it effectively		√	√	√	√	√	√
		Prioritise and post-implement review of the change		√	√	√	√	√	√
2	Evidence-based Decision-making	Analyse data through appropriate methods	√	√	√	√	√		
		Use the analysis of processes data to inform decisions	√	√	√	√	√		
		Evaluate the effectiveness of actions taken to address risks	√	√	√	√	√		
		Evaluate the effectiveness of actions taken to address opportunities	√	√	√	√	√		
		Monitor performance	√	√	√	√	√		
		Measure performance	√	√	√	√	√		

		Analyse performance	√	√	√	√	√		
		Conduct internal audits	√	√	√	√	√		
		Evaluate individual performance	√		√	√	√		
		Ensure access to exact and reliable data	√	√	√	√	√		
		Strike a balance between practical experience and data analysis	√	√	√	√	√		
		Combine methods of dialogue, discussion, negotiation, research and analysis for decision-making		√	√	√	√		
		Avoid jumping to conclusions before having all the information, as this may lead to frustrating other stakeholders		√	√	√	√		
		Understand the process by which decisions are formed and monitor the outcome to ensure smooth progression		√	√	√	√		
3	**Client Focus**	**Understand the current clients' requirements**	√	√	√	√	√	√	√
		Understand future clients' requirements	√	√	√	√	√	√	√
		Measure client satisfaction	√	√	√	√	√	√	√
		Exceed client expectations	√		√	√	√	√	
		Focus on the intangible advantages to increased client satisfaction	√		√	√	√	√	
		Ensure the project objectives match the client's requirements	√	√	√	√	√	√	√
		Ensure the project objectives match the client's expectations	√	√	√	√	√	√	√
		Clients are treated with respect and courtesy and empathise with their situation		√	√	√	√	√	√
		Do not leave the client waiting and let them know what is being done, commit to responding		√	√	√	√	√	√

		Conduct external measurements and surveys for the client's needs and engage seriously with the results		√	√	√	√	√	√
4	**Non-standardisation**	**Develop quality system documentation**	√			√	√	√	
		Enhance quality system documentation	√			√	√	√	
		Improve the efficiency of processes through documentation	√	√		√	√	√	
		Standards and binding regulations must be included in contracts		√		√	√	√	
		Contract with consultants during the project lifecycle		√		√	√	√	
5	**Engagement of People**	**Facilitate the open discussion of issues**	√	√	√	√	√	√	√
		Facilitate the open discussion of barriers	√	√	√	√	√	√	√
		Enhance the motivation of personnel	√	√	√	√	√	√	√
		Promote quality issues through efficient teamwork	√		√	√	√	√	
		Increase employee satisfaction	√		√	√	√	√	
		Ensure that employees' abilities are utilised	√	√	√	√	√	√	√
		Ensure that employees' abilities are valued	√		√	√	√	√	
		Clarify work priorities and define the roles and responsibilities of the project team		√	√	√	√	√	√
		Carry out cyclical meetings to review the project status, to inform the team on progress and monitor for conflict		√	√	√	√	√	√
		Build trust between the project team and project leadership and between teams		√	√	√	√	√	√
		Involve people with ideas and encourage them to provide their perspectives and encourage groupthink		√	√	√	√	√	√

		Explore the project's components and discuss clearly the project's importance with staff members.		√	√	√	√	√	√
6	**Leadership**	**Establish a vision for the project**	√	√	√	√	√	√	√
		Establish a pathway for the project	√	√	√	√	√	√	√
		Empower employees	√		√	√	√	√	
		Equip employees	√	√	√	√	√	√	√
		Create trust with employees	√	√	√	√	√	√	√
		Ensure commitment to the role	√	√	√	√	√	√	√
		Ensure commitment to policy	√	√	√	√	√	√	√
		Ensure responsibility to project partners	√	√	√	√	√	√	√
		Reduce the environmental impact	√		√	√	√	√	
		Identify challenging targets	√	√	√	√	√	√	√
		Promote high-quality processes	√		√	√	√	√	
		Ensure the efficient use of resources	√	√	√	√	√	√	√
		The leadership must acquire complete awareness of the project's requirements		√	√	√	√	√	√
		Emphasise motivation and team building to allow different members to collaborate		√	√	√	√	√	√
		Conduct a study for the project with the team and the stakeholders during the planning phase to comprehend project requirements		√	√	√	√	√	√
		Understand how to prioritise and the goals, objectives and requirements		√	√	√	√	√	√
		Manage activities as processes	√	√	√	√	√	√	√

7	Process Approach	**Reduce activities that add no value**	√		√	√	√	√	
		Reduce processes that add no value	√		√	√	√	√	
		Conduct audits of processes	√		√	√	√	√	√
		Improve processes to prevent nonconformities	√		√	√	√	√	
		Determine the knowledge necessary for the operation of processes	√		√	√	√	√	
		Maintain the knowledge necessary for the operation of processes	√		√	√	√	√	
		Take action to address risk	√	√	√	√	√	√	√
		Take action to exploit opportunity	√	√	√	√	√	√	√
		Gauge the feasibility of activities	√	√	√	√	√	√	√
		Determine links between activities	√	√	√	√	√	√	√
		Manage and monitor every process and control, measure the results, and report		√	√	√	√	√	√
		Evaluate and improve the processes is a constant, systematic and repetitive procedure		√	√	√	√	√	√
		Ensure the appropriate methodologies, resources, personnel and tools are available for each planning process		√	√	√	√	√	√
		Assure that all those involved in the project have an appropriate understanding of the process level		√	√	√	√	√	√
8	Relationship Management	**Share information with stakeholders**	√	√	√	√	√	√	√
		Share plans with stakeholders	√	√	√	√	√	√	√
		Share resources with stakeholders	√		√	√	√	√	
		Share expertise with stakeholders	√		√	√	√	√	

		Cooperate in the development of activities	√	√	√	√	√	√	√
		Establish effective intra-project-partner cooperation	√	√	√	√	√	√	√
		Manage effective intra-project-partner cooperation	√		√	√	√	√	
		Establish short-term relationships	√	√	√	√	√	√	√
		Establish long-term relationships	√	√	√	√	√	√	√
		Engage stakeholders effectively and frequently		√	√	√	√	√	√
		Ensure that all parties comprehend the overarching project aims		√	√	√	√	√	√
		Promote good stakeholder relationships		√	√	√	√	√	√
		Assess the stakeholders' behaviour and needs		√	√	√	√	√	√
9	**Skills and Training**	**Train personnel in terms of quality**	√			√	√	√	
		Share knowledge	√	√		√	√	√	
		Share the quality aims and characteristics	√	√		√	√	√	
		Teach the quality aims and characteristics	√			√	√	√	
		Manage communication	√			√	√	√	
		Remind staff how and what they can improve on		√		√	√	√	
		Comprehensively explain the project's scope to the team		√		√	√	√	
		Offer and receive feedback regularly to improve performance		√		√	√	√	
10	**Continuous Improvement**	**Provide resources for continuous improvement**	√	√	√	√	√	√	√
		Manage resources for continuous improvement	√	√	√	√	√	√	√
		Provide documentation for corrective action	√	√	√	√	√	√	√

		Enable the project team to participate in improvement	√	√	√	√	√	√	√
		Conduct operational planning	√	√	√	√	√	√	√
		Conduct operational control	√	√	√	√	√	√	√
		Identify the requirements	√	√	√	√	√	√	√
		Measure improvement consistently	√	√	√	√	√	√	√
		Analyse performance	√	√	√	√	√	√	√
		Celebrate improvement	√		√	√	√	√	
		Develop a reward system	√	√	√	√	√	√	√
		Effectively and continuously learn from project experience		√	√	√	√	√	√
		Dissemination of internal awareness on continuous improvement		√	√	√	√	√	√
		Ensure the adequate documentation of organisational responsibilities on the project		√	√	√	√	√	√
		Listen to and manage relationships with clients and other stakeholders		√	√	√	√	√	√
		Performance measurement at the processes level		√	√	√	√	√	√

5.12 Conclusion

This chapter described the investigation stage of the research, where the findings (critical success factors and factor components) from the literature review were analysed through a quality management survey. The goal of the survey was to gain improved insight and understanding of the critical success factors to support the effective implementation of the ISO 9001 QMS in UK construction projects and achieve successful project outcomes, as viewed by project managers. Since this research focuses on the UK context and the ISO 9001 QMS, the data of interest were from project managers from UK-based construction companies engaged as contractors, where the companies were both ISO 9001 certified *and* implemented the quality management system in their projects.

The initial results of the quality management survey were discussed and compared with the literature, where it is clear that quality management in construction projects offers huge potential in terms of achieving successful outcomes. Construction companies are still suffering from the inability to benefit from the capabilities and advantages provided by the ISO 9001 standard in projects, while the successful implementation and improvement of QMSs in construction projects relies on a range of factors (Sadikoglu and Zehir, 2010). The literature review found performance in terms of the ISO 9001 standard to be reliant on a variety of critical success factors (n=10) and factor components (n=82) that are vital to support effective implementation. The quality management survey thus empirically evaluated whether the identified factors are indeed critical success factors, that is, activities that must be undertaken effectively for the organisation/ project to succeed (Fryer et al., 2007).

Through the analysis of the results emerging from the quality management survey, there was agreement with the literature for some critical success factors and components, and differences in others. For example, certain factor components were accepted in the Likert scale responses of the participants, while others were rejected. Next, the level of importance in the compare means test was found to be weak for the 'reduce the impact of non-standardisation' and the 'skills and training' critical success factors, and therefore these were provisionally excluded as critical success factors and factor components, pending validation in the next stage of the research. The data was then analysed through the Kendall's W and Kruskal–Wallis statistical tests, with positive results emerging. However, analysis through the Spearman correlation coefficient test showed no significant relationship between evidence-based decision-making and effectively applying the ISO 9001 QMS in construction projects, and so this critical success factor was also provisionally excluded, pending validation. Therefore, after analysis, this study identified 7 critical success factors and 73 components that are pertinent to support successful implementation of ISO 9001 in UK construction projects.

The findings that emerged from the quality management survey will be used to support the design of the semi-structured interview questions in the next stage (Validation), to validate the results of the survey in order to refine and improve them through seeking the perspectives of project managers engaged in the field of construction in UK contexts.

Chapter 6

The Validation Stage

6.1 Introduction

This study's primary aim is to investigate the critical success factors for effective ISO 9001 QMS implementation in UK construction projects through the perceptions of UK construction project managers in order to improve the performance of the project and the likelihood of a successful outcome. In Chapter 2, a review of the literature in the context of UK construction was carried out, while in Chapter 3 the literature surrounding ISO 9001 implementation was comprehensively reviewed, with the critical success factors extracted along with the associated factor components, which were then tested in Chapter 5 through a quality management survey distributed to UK construction project managers from construction companies engaged as contractors, where the UK-based companies were both ISO 9001 certified *and* implemented the quality system in their projects. In this chapter, the findings resulting from the questionnaire survey will be validated in order to confirm their inclusion as critical success factors, and to gain insight into how and why these manifest in UK construction projects. The chapter begins by exploring the design of the interviews, before presenting the validation findings in discussion format, where verbatim excerpts are included to convey the project manager interviewees' first-hand perceptions through their responses. Finally, a summary of the interview and validation process is given, which includes the final series of critical success factors as the outcome of this research.

6.2 Interview design

Interviews can be carried out through either structured, semi-structured or unstructured approaches, as described in section 4.8.3. In this research, the semi-structured interview was selected as the most effective means of validating the findings that emerged from the quality management survey. Robson and McCartan (2016) underscored that semi-structured interviews are most suitable when the researcher is closely tied to the research, such as independent studies where the researcher is also the interviewer. The technique was selected as it would provide the researcher with the opportunity to explore the participants' perceptions on the benefits and challenges of implementing the ISO 9001 QMS in UK construction projects, as well as their agreement or disagreement with the findings emerging from the quality management survey. Saunders et al. (2016) described the interview technique as a dialogue with purpose, where the interviewer must strive to establish a rapport and ask clear and concise questions. Easterby-Smith et al. (2016) underscored that while interviews are more resource intensive because the interviewer must attend in person, they facilitate the collection of more accurate data since the interviewer can reassure the participant on the measures in place to keep the data safe, as well as the importance of the data to the research. Kvale (1996) introduced a 7-stage structured process for investigating through interviews: (i) thematising, where the purpose of the investigation is formulated; (ii) designing, to establish and assure that the targeted information is gathered; (iii) interviewing, to conduct the interviews based on the schedule while using a reflective approach to the knowledge sought; (iv) transcribing, to convert the responses into textual format; (v) analysing, using appropriate methods determined by the purpose and topic of the study, and the nature of the interview data; (vi) verifying, to establish the generalisability, reliability and validity of the findings; and (vii) reporting, to communicate the findings of the study.

6.2.1 Interview objective

The objective of the interviews was to validate the critical success factors and factor components resulting from the quality management survey in Chapter 5, by seeking the interviewees' perspectives on those factors and factor components deemed critical and non-critical by the quality management survey participants.

6.2.2 Interview questions

Conducting interviews of high quality requires the design of interview questions, to be included in an interview schedule. These questions must be appropriate to achieve the objectives of the interview, as described in the previous section. In this study, the interview schedule comprised of an introduction to the researcher, the study and its importance. All questions were open-ended, which as Robson and McCartan (2016) highlighted, allows the researcher to conduct a more precise assessment of the interviewee's beliefs on the topic. This was followed by assurances regarding confidentiality and maintaining the anonymity of the interview participants. The first two questions explored the participant's background in terms of the years of experience and field/ sector that their company worked in. These were followed by a group of three questions exploring (i) the status of the participant's company's use of the ISO 9001 QMS in its construction projects, (ii) the perceived challenges of implementation, and (iii) the perceived benefits. After this, the participants were presented with Table 5.34 from Chapter 5, describing the critical success factors for effective implementation of the ISO 9001 QMS in construction projects. After reviewing the findings, the participants were asked ten questions exploring their views on the critical success factors emerging from this study, to determine their agreement or disagreement with those accepted and rejected by the respondents of the quality management survey. A copy of the questions included in the validation interviews can be found in Appendix 4.

6.2.3 Interview reliability and validity

As per the recommendation from Saunders et al. (2016), each interview question was read out in the same form and in the same tone of voice to avoid any bias from being introduced, while the responses were digitally recorded. In terms of validity, Neuman (2014) described that in social research, we learn more when we can observe a phenomenon from multiple perspectives, with increasing confidence that an accurate understanding has been acquired if the different measures offer a similar perspective. But how can we assure the reliability and validity of the interviews? Saunders et al. (2016) described reliability as the ability to consistently replicate the design and findings. In this study, the same interview questions were asked in the same order for all six interviews, with the researcher using a neutral tone of voice and avoiding the introduction of any bias through his responses. In terms of the external validity, which Bryman (2012) referred to as the extent that the findings can be generalised, this is thought to be strong since the interview questions were based on critical success factors reported in the literature and either confirmed or rejected by the participants of the quality management survey. However, there was a threat to the validity of the interview questions in terms of their internal validity (Saunders et al., 2016), since the participants were made aware of the findings from the quality management survey, which may have influenced their responses through the desire to concur with the findings from the broader quality management survey (participant bias).

6.2.4 Selection of interviewees

The participant project managers were selected purposefully from UK construction companies engaged as contractors, with the aim of including those who would offer the most rich and pertinent views (Yin, 2016). A set of criteria were applied to consider the participant eligible for the interview:

- Employed as a project manager of a construction company engaged as a contractor
- Activities based in the UK
- A minimum required knowledge on the subject (i.e. 10 years' experience)
- The company is ISO 9001 certified
- The company implements the ISO 9001 QMS in their projects

A total of six participants was considered by the researcher to be a sufficient sample for the validation interviews in this research. Regarding the optimum sample size, Robson and McCartan (2016) cautioned that there is no ready answer for this, as many factors influence the sample size such as the accessibility of the participants, the resources available to the researcher, and the physical practicalities of processing the transcripts, particularly for qualitative, open-ended interview questions. Therefore, while it is acknowledged that a larger sample may have allowed additional insights to be gathered, it is asserted that six interviews were seen by the researcher to be a sufficient and feasible number to validate the findings from the quality management survey. The details of the six interviewees who participated in the semi-structured interviews for this study can be found in Table 6.1, where their identities have been anonymised (i.e. P1, P2, ...).

Table 6.1: Profiles of the interview participants

Participant	Gender	Position	Experience	Field	Applies ISO 9001
P1	Male	Project manager	46 years	Private sector, third-party inspection (public sector)	√
P2	Male	Project manager	35 years	Residential construction	√
P3	Male	Project manager	42 years	Private sector construction, heritage	√
P4	Male	Project manager	26 years	New build construction	√
P5	Male	Project manager	30 years	Public and private sector	√
P6	Male	Project manager	35 years	General construction	√

6.2.5 Interview process

Face-to-face semi-structured interviews were carried out with six project managers from UK construction companies from June to August 2019. Prior to the interviews taking place, the researcher contacted the organisations to inform them of the nature of the study, offer reassurance regarding the participants' confidentiality and anonymity, and invite the project managers to participate. Once initial agreement to participate had been received, the researcher contacted each participant to arrange a convenient time and place to conduct the interview. For each interview, the researcher attended the project site, where he initially introduced himself and stated the research aim and objectives, as well as the ethical measures in place to protect the participants and their data. Each interview lasted approximately 30 minutes. At the beginning of each interview, the participants were presented with the findings from the quality management survey, where they reviewed the findings presented in Table 5.34. It was requested that the interview be digitally recorded to allow later transcription to take place; however, one of the interviewees expressed a preference for the researcher to only take written notes during the interview. In the case of the digitally recorded interviews, these were transcribed soon after the interview was complete, while in the case of the handwritten notes, these were reviewed and rewritten as soon as possible after the interview in order to add any other pertinent information that had been expressed.

6.2.6 Ethics

All the interview participants were assured that their identity would be anonymised, and that their data would be kept secure at all times on the University's encrypted server (see the validation interviewees' information sheet in Appendix 5). Furthermore, it was confirmed that once the study has been completed and the thesis has been examined, all the interview data will be destroyed. The participants were informed that they could withdraw from the study at any time, without needing to provide any particular reason. Moreover, ethical approval for this study was received by the University of Salford's Research and Innovation and Academic Engagement Ethical Approval Body (see Appendix 3). Therefore, what Saunders et al. (2016) referred to as the 'ethical integrity' of the researcher was maintained at all times.

6.2.7 Interview analysis

With the responses collected from the interviews, this section describes how the responses were analysed through content analysis. Schreier (2014) defined qualitative content analysis as a systematic approach for describing the meaning of qualitative data by applying codes to the different parts of the material. Saunders et al. (2016) described content analysis as an approach that applies codes and categories to qualitative data to enable quantitative analysis. Easterby-Smith et al. (2015, p.188) stated that although content analysis can be used with any type of data, it is particularly suited to "company reports, observational records, interview transcripts and diaries". There are a number of benefits to content analysis, such as the data being in a permanent form that allows re-analysis (Robson and McCartan, 2016), and the ability for the process to be replicated (Bryman, 2012); Robson and McCartan (2016) cautioned that as bias can be introduced in documents, triangulation should be employed to overcome this.

In this study, the objective of the content analysis was to validate the findings from the quality management survey. Since there were only six interviews, it was decided that analysis through software such as NVivo would not be necessary, with Bryman (2012) advising that the time required to become familiar with new software is not rewarded when the data set is small in size. Robson and McCartan (2016) described the thematic coding approach, whereby a generic approach is adopted that enables all parts of the data to be coded and labelled, without necessarily being underpinned by any theoretical perspective. Schreier (2014) asserted that the main themes in content analysis are the areas where the researcher would like to gather more information, with the categories featuring the detail of these observations of the main themes. The codes applied in content analysis may be sourced from (i) terms applied by the participants themselves, often referred to as 'in vivo' codes; (ii) labels developed by the researcher that optimally describe the data unit(s); or (iii) the literature and/or earlier parts of an investigation, in which case they can be referred to as 'a priori' codes (Saunders et al., 2016). Robson and McCartan (2016) asserted that when allocating content into categories, this process should continue until every relevant chunk of data has been allocated to a specific category. Moreover, they asserted that while thematic content analysis can be applied inductively to allow the themes and codes to emerge from the data, it is equally acceptable for the themes and codes to be predetermined prior to the analysis (Robson and McCartan, 2016). The themes and codes are used to collect similar data items that can be utilised in response to answering a research question, proving or disproving a hypothesis (Miles et al., 2014), or in the case of this study, validating the preliminary findings from the quality management survey.

In this research, a manual coding frame was developed from Table 5.34, with the 10 critical success factors labelled as themes A–J, and the 82 factor components as categories (e.g. A1–A8, B1–B15, etc.). To prepare for the data analysis, 'initial' coding was carried out to allocate the interview data into conceptual units (Saunders et al., 2016), based on the relationship of the interviewees' responses to each of the critical success factor themes that emerged from the quality management survey (see Figure 6.1).

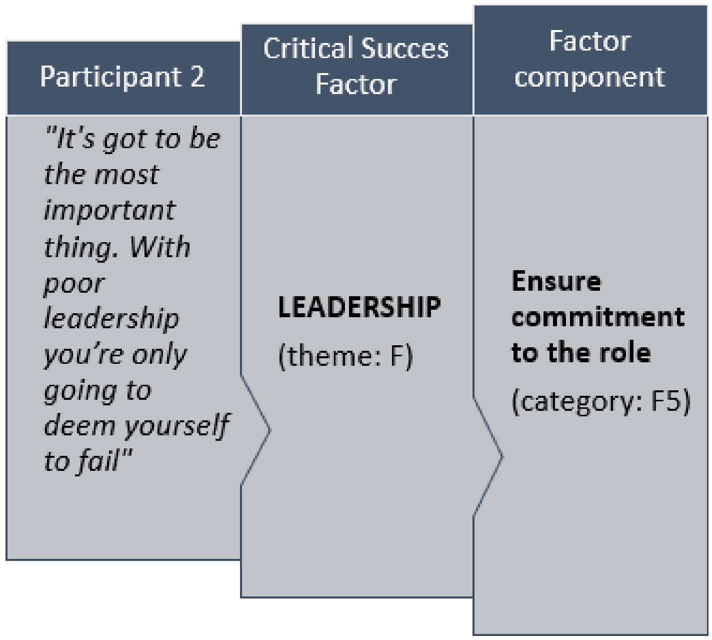

Figure 6.1: Example of the coding process in the leadership theme

Furthermore, some of the responses were found to link to several themes, and so they were placed in each associated category, pending further analysis. The next stage involved 'focused' coding (Saunders et al., 2016), where the data in each category was analysed to determine its relationship to the existing factor component categories that required validation, while remaining vigilant for any new categories that might emerge from the interviewees. After this, a process that Easterby-Smith et al. (2016) referred to as 'linking' took place, where the associations between the chunks of interview data and the critical success factors in general, and the individual factor components in particular, could be conceptualised in closer detail. Finally, the data allocated to the themes and categories was re-evaluated iteratively until the researcher was confident that all the assigned validation data had been allocated correctly, and that any remaining data was either not relevant to the validation process, or that it had emerged in sufficient frequency to justify assignment to a new category (i.e. a new factor component emerging from the validation interviews). Figure 6.2 visually presents the data coding process.

Figure 6.2: The data coding process

Therefore, the content analysis comprised of reading and re-reading the interview transcripts, and allocating codes to chunks of the interviewee's responses that either linked to the established themes and categories, or represented new ones, with the researcher remaining alert to the belief that new insights or perceptions could also emerge through the interviews at any time. The researcher believes that the successful assignation of the overwhelming majority of the data to the established themes and categories justified the coding scheme as being well matched to the data (Schreier, 2014). Once fully categorised, the data was then compared with the results from the quality management survey analysis in order to validate the findings, as discussed in the following section.

6.3 Discussion of the findings

To achieve the objective stated in section 6.2.1, namely to validate the critical success factors and factor components resulting from the quality management survey in Chapter 5 by seeking the interviewees' perspectives on those factors and factor components deemed critical and non-critical, this section presents the researcher's interpretations of the findings emerging from the interviews, with qualitative interview excerpts included to support the interpretation.

After verifying that all the participants' organisations employed the ISO 9001 QMS in their projects (see Table 5.1), the interviewees were queried on the general benefits and issues that arise when using the ISO 9001 QMS. No issues were raised specifically, but a number of advantages were brought up. For example, Participant 6 highlighted the value that ISO 9001 brings in terms of winning bids for new contracts, "*Yes, and for obtaining projects, people want to see ISO accreditations. So, to win projects you need the accreditations*", which is an external benefit in terms of enhancing the organisation's ability to win more clients and contracts (Manders et al., 2016). This participant also mentioned the advantage of the use of a computer-based tool called

FieldView to manage quality and raise defects while managing inspections throughout the site, which links to the notion of ISO 9001 reducing the issues that arise within a project, and the impact on the liability period (Aized, 2012; see section 3.6). Then, Participant 2 cited the QMS's ability to ensure "*that we have a good quality project handed over to the client*" due to the quality plan and quality systems.

The following sections explore the interviewees' responses regarding the ten critical success factors emerging from the literature and explored through the quality management survey to confirm the validation or rejection of these critical success factors and the associated factor components.

6.3.1 Change management

In terms of the change management success factor, all the participants agreed on its importance in supporting effective implementation of the ISO 9001 QMS in UK construction projects, where they reviewed and confirmed the findings from the quality management survey presented in Table 5.34, with three of the participants mentioning the need to plan for change:

- *A full week plan ahead is what we do. (P4)*
- *Monitor and keep good records is vital for management because of change. If something changes, if I leave, then someone comes in and steps into my role. (P5)*
- *Very important. (P6)*

Changes are inevitable throughout the construction project lifecycle (Ajayi and Mohamed, 2015), which are typically associated with cost and time overruns, conflict, and rework. Hoyle (2018) underscored the value of planning for change (see section 3.9), with Participant 6 raising an excellent point in that record keeping allows change in plans or personnel to be negotiated without negatively impacting on the project. Participant 2 also brought up the need for proactive change management, declaring: "*If you fail to plan, you plan to fail*". Participant 3 asserted the promotion of continual improvement by stating "*We constantly strive to improve. We have to because all your competitors do. If they are good competitors that's what they'll be doing*", which aligns with the assertion by Rumane (2018). Four of the respondents to the quality management survey underscored the importance of educating clients and other stakeholders on the negative outcomes of unnecessary change, with this belief confirmed by Participant 1 who cautions his clients on the cost and time implications of their changes: "*For example, if the client comes to us and he wants* *to make a change in the design, we inform them that this will affect the cost and the timeline*". In terms of educating clients on the implications for change, this is vital as they may not return for future work if they are not satisfied with the service or product provided (Hoyle, 2018), and thus they must be informed of the impact of their changes on the project with regard to the cost, quality, and time.

The merit of anticipating change and addressing it effectively was brought up by two of the respondents to the quality management survey in their additional comments, and this factor component was validated by three of the interviewees both in the project's planning stage, "*We consider the potential changes throughout the project lifecycle before the project starts*" (P1), and whilst the project is underway in order to (i) remain on the critical pathway, "*If you start to lose it, if you start to come off what you would call your critical path, then you will struggle to pull it back on track*" (P3), and (ii) to learn from previous experience: "*this is the previous issues that we've had on site. This is what we need to watch out for*" (P5). In terms of the latter, there is a need to conduct a review of change, which can occur before or after the change occurs, and will determine its suitability or effectiveness (Hoyle, 2018).

One new factor component that emerged from the interviews was cooperation within the project team to 'embrace the change as a team', with Participant 5 stating that if change is required "*everyone in the team needs to get involved*", while Participant 6 believed that collaboration within the team is vital: "*you need to deal with it, and for everybody to get on board for any changes and distribute that to the whole team. The change and the reasons why*". This echoes Arditi and Gunaydin's (1997) finding that working efficiently as a team is a critical factor with implications for the quality outcomes (see section 3.9), which emerged from their research using questionnaires to illuminate the views of construction industry practitioners regarding what factors impact on the process quality of a construction project. The participants in that study asserted that cooperating with efficiency and coordinating effectively helps to address change at the design stage, while strong cooperation at the contractor level can help to avoid conflict.

In terms of the validation, the change management critical success factor was thus validated by the interviewees, as well as four factor components and one new factor component that emerged (see Table 6.2), with no factor components being rejected.

Table 6.2: Validated factor components: change management

• Plan for change • Promote continual improvement • Educate clients and other stakeholders on the negative outcomes of unnecessary change • Anticipate change and address it effectively • Embrace the change as a team *

* New factor component emerging from the validation interview

6.3.2 Evidence-based decision-making

Despite the literature asserting the importance of the evidence-based decision-making QMP (see section 3.4.2.6), such as analysing data through appropriate methods (Medić et al., 2016), evaluating the effectiveness of actions taken to address risks (Fonseca and Domingues, 2017a), evaluating individual performance (Hoyle, 2018), and ensuring access to exact and reliable data (Fonseca and Domingues, 2017a), this critical success factor and its factor components were rejected by the project managers in the quality management survey, as well as the interviewees after their appraisal and review of the questionnaire findings. The general consensus that arose during the interviews was that experience guides decisions to a higher degree than evidence. For example, Participant 2 reported that "*Evidence is good, but experience usually takes the overriding factor in making decisions*", while Participant 3 believed that experience is the criterion that supports decision-making, which then leads to the generation of evidence: "*Your experience tells you why you're going to do it. The evidence comes later, doesn't it?*". Participant 5 exemplified this generation of evidence by describing how his experiential on-site decisions are recorded and forwarded to the office, but that these decisions are his responsibility, based on his experience:

> *Yes, if I make any decisions on site, we've got a book basically inside that records any decisions we are making. So, if I make any decisions, I write it in and I send it to my office every week. Any decision made on site at the end of the day, the last stop is me.*

Therefore, the evidence-based decision-making critical success factor that emerged from the literature review but was rejected by the Spearman correlation coefficient test in Chapter 5 (see section 5.10), was also rejected by the interviewees and is thus confirmed as excluded from the critical success factors required to promote effective implementation of the ISO 9001 QMS in UK construction projects. This represents a surprising finding of the study, as evidence-based decision-making is one of the ISO 9001:2015 QMPs, where the outcome of the data and information analysis is deemed to have a higher possibility of generating the intended outcomes (Hoyle, 2018).

6.3.3 Client focus

The interviews then moved on to the client focus QMP, where all of the participants reviewed and confirmed the findings from the quality management survey presented in Table 5.34. Four of the participants underscored the need to understand the requirements of current clients to ensure future work, recommendations and an enhanced reputation. Their comments included:

- *It gives us repeat business. It also helps the reputation of the company if you are doing quality projects and making sure the client is happy. (P2)*
- *Client focus? Oh yes, absolutely. We have to give what the client wants. If we don't give what the client wants, we won't get any more work off them. (P5)*
- *Yes, you need to know the client and you need to get the quality right for the client because he's going to either use you again or he's going to recommend you for other work. (P6)*

Linked to this factor components, Participant 6 also asserted the need to understand future clients' requirements, whereby "*to win future work we need to have a good quality standard, and that's what we aim for*", and thus highlighting the importance of comprehending the requirements of both current and future clients (Luburić, 2015; see section 3.4.2.1).

Participant 5 described how his organisation strives to ensure that the project's objectives match the client's requirements by reviewing the client's needs and then submitting the contractor's proposal: "*They give us the client proposal, so we get like a proposal from the client, a contract proposal, and then we give them back the contractor's proposal*". Participant 3 reported on the importance of such objectives meeting the client's expectations, "*... that's why you have to have so many meetings with the client. They are, well they're top of the food chain, aren't they? They are the customer, they are paying for the finished result of whatever it is you are doing*", while highlighting the essential role of the client, whose expectations are central to a successful project outcome. Both these responses underscore the importance of synergy between the project's objectives and the client's requirements and expectations (Fonseca and Domingues, 2017b; see section 3.9).

In summary, the client focus critical success factor was validated by the interviewees, as well as four factor components (see Table 6.3), with no new factor components resulting from the interviews and no factor components being rejected.

Table 6.3: Validated factor components: client focus

• Understand the current clients' requirements • Understand future clients' requirements • Ensure the project objectives match the client's requirements • Ensure the project objectives match the client's expectations

6.3.4 Reduce the impact of non-standardisation

In terms of the importance of non-standardisation to support effective implementation of the ISO 9001 QMS in UK construction projects, this critical success factor was rejected by the compare means test in Chapter 5 (see section 5.7), as well as the interviewees after their appraisal and review of the questionnaire findings. Despite the literature asserting the importance of reducing the impact of non-standardisation in construction projects (see section 3.9) such as through developing and enhancing quality system documentation (Rumane, 2018), and improving the efficiency of processes through documentation (Ramaji and Memari, 2015), *and* the responses from the quality management survey of ensuring that standards and binding regulations are included in contracts, as well as contracting with consultants during the project lifecycle, the interviewees were non-committed about its importance as a success factor. Participant 1 stated "*While following the standardisation manuals can be helpful, it is less important than focusing on other factors*", while Participant 3 pointed out that in his current project in a heritage building context, the standard building approaches have to be modified to suit its bespoke nature:

> *You get a job like this, and this is what you call a heritage building. There won't be anything standard about it, it's not like a normal build. Say you've got a new build and you expect*

> *certain things. You've got all your standard construction methods and methodologies, and then you come onto a traditional heritage building like this and you've gone right off standard.*

It appears that as these project managers were focused on managing the project on the ground, they had less motivation or time to focus on the development of documentation and strategies to address the issues of non-standardisation in construction.

In summary, none of the three factor components that emerged from the literature or the two from the quality management survey were validated by the project managers in the interviews, and as the critical success factor also failed the compare means test, non-standardisation and its associated factor components are thus confirmed as being rejected as a critical success factor in this study.

6.3.5 Engagement of people

The next critical success factor to be explored in the interviews was engagement of people, where the interviewees reviewed and confirmed the findings from the quality management survey presented in Table 5.34. Participants 1 and 6 agreed with the need to facilitate open discussion amongst the project team of issues in terms of quality, stating, "*We have frequent discussions regarding any issues facing us in the project lifecycle*" (P1) and "*We tend to do more with the sub-contractors. Have meetings with them. Raise any quality issues with them*" (P6), thus underscoring the importance of creating an open forum for the discussion of issues that arise (Fonseca and Domingues, 2017a; see section 3.4.2.3). Participant 3 focused on the need to increase the personnel's motivation and loyalty through ensuring a positive working environment, "*That's why I've got to make my sites a nicer place for them to work, than them wanting to go and work elsewhere*", while placing emphasis on their wellbeing: "*we try and help everyone through mental health, through their work ... We do quite a lot with them*". This echoes Mansour et al.'s (2019) reference to enhancing employees' motivation, which increases their focus on the goals and values of their organisation and project (see section 3.4.2.3).

Regarding a factor component emerging from the quality management survey, Participant 4 raised the importance of communication and defining the priorities, responsibilities and roles of the project team to ensure that quality issues are addressed through efficient teamwork: "*If your sub-contractors don't know what you expect of them, then the job is going to go haywire. You know* *things aren't going to get communicated, things will go wrong, which causes you issues ... on site*". In terms of conducting regular meetings, there was strong agreement on this to keep staff updated, "*We meet staff regularly and use a projector to present all updates*" (P1), to review progress, "*We do have weekly meetings where we discuss each contractor*" (P2), and with all stakeholders to ensure the project remains on track: "*Meetings every day. With staff, sub-contractors, meeting with the client, meetings with the banks, releasing the funds, drive the project*" (P4). This agrees with the 'carry out cyclical meetings' factor component raised through the participants' additional responses to the quality management survey. In respect to another factor component emerging from the quality management survey, two of the participants asserted the need to engage people with ideas and groupthink, while offering encouragement for their perspectives:

- *we take their opinions into account.* (P1)
- *We have processes we go through ... that we regularly meet to discuss: are we doing everything right, can we do things better?* (P3)

In terms of the validation, the engagement of people critical success factor was thus validated by the interviewees, as well as five factor components (see Table 6.4), with no new factor components resulting from the interviews and no factor components being rejected.

Table 6.4: Validated factor components: engagement with people

• Facilitate the open discussion of issues
• Enhance the motivation of personnel
• Clarify work priorities and define the roles and responsibilities of the project team
• Carry out cyclical meetings to review the project status, to inform the team on progress and monitor for conflict
• Involve people with ideas and encourage them to provide their perspectives and encourage groupthink

6.3.6 Leadership

The interviews then shifted to the leadership success factor, which generated great interest. All the interviewees reviewed and confirmed the findings from the quality management survey presented in Table 5.34. Participant 1 focused on the need for leaders to have good project awareness and to prepare effectively before the project begins, "*[Leaders] should have a good understanding of the project and should implement their work before the project starts*", echoing the claim that the leader has a responsibility for the creation of both a vision and a pathway for the project (Medić et al., 2013; see section 3.4.2.2).

Creating trust with employees was a popular theme echoed in the literature (Chiocchio et al., 2011; see section 3.4.2.2), with Participant 4 believing that a good leader should lead by example, "*If you are a good leader, people follow*", and Participant 5 expressing the importance of humility to show that mistakes can happen to anyone and that they allow people to grow: "*I'm the first person to put my hands up and say I've made a mistake because you know, going forward, once you rectify the issue it won't happen again*".

It is important for leaders to demonstrate their commitment to the role (Mansour et al., 2019), with Participant 2 citing the dangers of poor commitment from leaders: "*It's got to be the most important thing. With poor leadership you're only going to deem yourself to fail*". Then, Participant 3 echoed a factor raised in the survey regarding the emphasis on motivation and team building to promote collaboration: "*I think a lot of it comes down to the team. It's not just one, it's not just the project manager*".

Participants 1 and 5 also raised the need for what Berg and Karlsen (2016) referred to as 'coaching leadership', whereby the project managers seek opportunities to promote the long-term development of their team through guidance and advice, in the belief that this will lead to long-term project success by releasing their potential (see section 3.4.2.2):

- *Wherever possible, work with team members to develop their skills. (P1)*
- *... your staff below, if they are doing something wrong. You need to explain to them properly what they are doing wrong. Help them and show them how to do it right. Then going forward you will be successful. They will be successful in doing it the right way. (P5)*

Berg and Karlsen (2016) explored coaching leadership practices in projects by conducting a case study on an organisation through semi-structured interviews with 12 project managers based on their experience and use of a coaching leadership style, where they found that (i) project managers should train their employees to lead, thus recognising that each employee can acquire greater awareness of their feelings and behaviour, as well as the potential results; and (ii) that employees can work together, alongside a leader, to construct a common culture.

In terms of the validation, the leadership critical success factor, itself an ISO 9001:2015 QMP, was therefore validated by the interviewees, as well as five factor components and one new factor component that emerged (see Table 6.5), with no factor components being rejected.

Table 6.5: Validated factor components: leadership

- Establish a vision for the project
- Establish a pathway for the project
- Create trust with employees
- Ensure commitment to the role
- Emphasise motivation and team building to allow different members to collaborate
- Coach personnel to release their potential *

* New factor component emerging from the validation interview

6.3.7 Process approach

The subsequent critical success factor to be explored in the interviews was the process approach, another of the ISO 9001:2015 QMPs, where the interviewees reviewed and confirmed the findings from the quality management survey presented in Table 5.34. Ensuring that activities are managed as processes (Sickinger-Nagorni and Schwanke, 2016) was a common theme raised by four of the project managers. Participant 3 referred to the processes via the programme of works, and the importance of following it, "*Basically you have a plan, a programme, a programme of works, and you've got to adhere to it*", while Participant 5 highlighted the ability of processes to support future projects moving forward: "*You standardise your whole practice so when you come to this site ...*

So, we go from this site and we take the same, we take the same procedures that we do here and we do it on every other site". Moreover, Participant 2 exemplified this process approach through the phases underway in his current project:

> *This is my building. So, you'll see number five, I can close in the ceilings and the baths and the showers. So, I know which one is going on at what time. So, number four is ready for the first-fix plumbers, and from that goes to number five, and it goes to number six. So, I can see the lifecycle of how we fit out each one of these plots.*

Two of the interviewees raised the issue of risk, and the need to take action to address it (Dumitrascu and Nedelcu, 2012; see section 3.4.2.4). Participant 3 highlighted the high degree of uncertainty in groundworks, "*things can go wrong because there's a lot of unforeseens. You know, doing excavations, you don't know what's underground before you start*", and Participant 1 gave an example of a potential dispute that was addressed at an early stage: "*In one of our projects there was the potential for a complaint to be made against us to the local authority, so we met the people involved to find a resolution before it could reach that point*".

Chiarini (2017) cited the need to determine the links that exist between activities (see section 3.4.2.4), and this was echoed in the survey responses. In the interviews, Participant 2 addressed this point by underscoring the importance of monitoring the processes so there is a high degree of awareness of when processes can be completed and the next ones start; for example, ensuring that the services are fully fitted before the ceiling and wall surfaces are applied:

> *So, this way when I know, if I'm closing the ceiling down, we can do our inspections in the ceiling before we board the ceilings up. So, then we look at 'close board and walls'. We can check all the electrics are in, all the plumbing is in. Everything else that goes in the walls. The same with the ceilings.*

The qualitative responses from the respondents in the quality management survey on the process approach critical success factor included managing and monitoring every process and control, measuring the results, and reporting, which was addressed by Participant 1 who stated "*You should have a programme and plan for all your activities and monitor everything*".

In summary, the process approach critical success factor was validated by the interviewees, as well as four factor components (see Table 6.6), with no new factor components resulting from the interviews and no factor components being rejected.

Table 6.6: Validated factor components: the process approach

• Manage activities as processes • Take action to address risk • Determine links between activities • Manage and monitor every process and control, measure the results, and report

6.3.8 Relationship management

Relationship management represents another of the ISO 9001:2015 QMPs and was the next critical success factor to be validated in the interviews in terms of its importance to support effective implementation of the ISO 9001 QMS in UK construction projects, where the interviewees reviewed and confirmed the findings from the quality management survey presented in Table 5.34, while addressing four of the factor components specifically. Three participants discussed information sharing with the stakeholders, with Participant 1 underscoring the importance of "*Continuously updat[ing] the stakeholders on any changes that may affect the project to improve communication*", Participant 3 referring to the weekly and monthly meetings conducted for this purpose, "*Each week we'll have progress meetings. So, we have the client, sub-contractors and the principal contractors ... Smaller meetings weekly and then monthly we'll have a meeting where everybody attends. This is when these [quality policies] are applied*", and Participant 6 stating that this factor component is "*Very important. Newsletters. Engagement with our neighbours*". These three excepts support the assertion that stakeholder relation management involves the dissemination of goals, knowledge, values, and understanding (Sickinger-Nagorni and Schwanke, 2016). In the context of sharing plans with the stakeholders, Participant 5 reported on the need for honesty and transparency: "*Absolutely. It's like an open book. You need to be very open with your client*", as affirmed in the literature by Hoyle (2018). Cooperation in the development of activities is vital (Hola, 2015; see section 3.4.2.7), and this was echoed by two of the interviewees, where Participant 3 noted the central and vital role of the project manager, "*You are like a central pin. Everybody needs you*", while Participant 5 declared that negotiating new approaches requires clear justification:

> *If there's issues or if you see something in the proposals that you don't like, you need to go to them straight away and explain to them. I don't like ... I don't want to do it this way. I want to do it this way, and this is why. (P5)*

The final factor component of the relationship management critical success factor that was addressed by the participants was the importance of ensuring healthy relationships with the stakeholders that emerged from the qualitative responses to the quality management survey. Participant 2 reported that he made sure he was always available, "*I always have an open-door policy*", while Participant 3 referred to the importance of being personable, "*You've just got to have a certain way ... you've got to be good with people. You've got to be a people person*", and Participant 4 underscored the benefits for the project's processes when there is good cooperation, which then leads to improved progress: "*I think if everybody sort of gets along it makes the process easier. You get more communication ... going forward*". Clearly these project managers recognised the value and importance of having good stakeholder relationships.

In terms of the validation, the relationship management critical success factor was therefore validated by the interviewees, as well as four factor components (see Table 6.7), with no new factor components resulting from the interviews and no factor components being rejected.

Table 6.7: Validated factor components: relationship management

- Share information with stakeholders
- Share plans with stakeholders
- Cooperate in the development of activities
- Promote good stakeholder relationships

6.3.9 Skills and training

The interview questions then turned to focus on the skills and training success factor, with this critical success factor rejected by the quality management survey participants through a low compare means test score (see section 5.7), as well as the interviewees after their appraisal and review of the questionnaire findings. In terms of the enable learning factor component (Willar et al., 2015; see section 3.9), Participant 1 reported that his organisation may offer short courses, but that the preference is to recruit skilled personnel or sub-contractors: "*Sometimes we give short courses, but we prefer ready skilled workers or to contract sub-contractors*". Participant 5 echoed the need for sub-contractors to continue updating their skills and knowledge, but that the responsibility for implementation would be with their third-party employers, "*The sub-contractors don't work for us. Well they do work for us but through a third party, so it's a case of yes they have to continue training*", while Participant 3 underscored the importance of regular training to update skills due to rapidly changing products and techniques, but did not refer to his organisation's responsibility for this: "*I think skills and training are very important because things are changing. The world is changing too fast. There are new products, there's new equipment, new ways of doing stuff all the time*". Therefore, despite the importance of equipping and empowering employees with the skills and resources required to fulfil their role (Neyestani and Juanzon, 2017b; see section 3.4.2.2), for these project managers this was a responsibility for the direct employers, that is, the sub-contracting companies.

In Participant 4's view, personnel having sufficient skills and training was a checklist exercise, whereby his organisation reviewed the qualifications of the sub-contractors' personnel, and anyone lacking the necessary skills, training or experience would be rejected:

> *We don't need to. Sub-contractors should be sending people with the correct skills and the right training and the right experience, or else .... We get to see all the qualifications on their induction. And if they're not trained, they don't come in.*

Participant 6 also underscored that his project's labour force was supplied by sub-contractors, while reflecting on his 35 years' experience and lamenting the changes in modern construction approaches leading to a requirement for lower skilled personnel to merely install components such as bathroom modules, which are fully manufactured elsewhere:

> *We have no direct labour ourselves, so what the problem is, is that a lot of the sub-contractors aren't training ... And the construction techniques used are trying to de-skill construction so you get less skilled people doing it. So instead of a bathroom pod you would have tillers, dry liners, everybody. Instead they make them in a factory.*

In summary, with none of the eight factor components that emerged from the literature review and the quality management survey being validated by the project managers in the interviews due to the responsibility for skills and training being placed on the sub-contractors, skills and training and its associated factor components are confirmed as being rejected as a critical success factor in this study.

6.3.10 Continuous improvement

The final critical success factor to be explored in the interviews in terms of its importance to support the effective implementation of the ISO 9001 QMS in UK construction projects was the continuous improvement QMP, where the interviewees reviewed and confirmed the findings from the quality management survey presented in Table 5.34. The project team should be enabled to participate in improvement (Mansour et al., 2019; see section 3.4.2.5), since as Participant 4 pointed out, this is in ongoing process: "*Sub-contractors aren't perfect, I'm not perfect. We all can improve ... Everybody's got to improve*". In this context, Participant 3 highlighted the regular team meetings in terms of how to improve, while Participant 6 underscored the progress that can be made by learning from mistakes:

- *We have a lot of meetings within the office. It could be all the project managers who get together one day to implement new things. We are constantly being taught how to, well basically how to run a successful construction site. (P3)*
- *Lessons learned. If any mistakes were made on the first fit. Like now we are doing phase 1. We've learned lessons on the quality that we are going to put right on phase 2. (P6)*

It is important to carry out operational control (Chiarini, 2017; see section 3.4.2.5), and this was addressed by Participant 2 who stated that his team members were absolutely clear on the respective tasks, where they would be carried out and that the work was being monitored: "*We know exactly what everyone's doing. We know exactly who should be where, and we know exactly who should be checking what*". Then, in terms of analysing the performance (Willar et al., 2015; see section 3.4.2.5), Participant 1 noted that in order to achieve successful outcomes he would regularly identify and revise the performance: "*Identify and update your targets and requirements throughout the project lifecycle to achieve the final aim*". In agreement with the point raised by the project managers in the quality management survey, Participant 3 discussed the importance of using each project's experience to inform and improve the next:

> *Learning from ... not always mistakes. Learning just from what you do when you do a build ... What could we have done better? It's not always what we did wrong, but what we could have done better.*

One new factor component that arose from the interviews was the need to engage in effective teamwork to enable continuous improvement. Participant 1 cited the importance of teamwork to the project outcome, "*Teamwork is important too. Everyone participating effectively to finish the job*", while Participant 2 focused on the positive impact that teamwork has on increasing the productivity, "*We need to make sure that the productivity keeps improving. And this is through communication and teamwork*", and Participant 3 expressed his team's ongoing emphasis on increasing the team's effectiveness: "*We are constantly striving to improve as a team*". Azmy (2012) reported that teamwork in construction projects plays a dominant role in ensuring a successful outcome through improved efficiency, reduced cost and the benefits that arise from the harmonious relationships that result.

In terms of the validation, the continuous improvement critical success factor was thus validated by the interviewees, as well as four factor components and one new factor component that emerged (see Table 6.8), with no factor components being rejected.

Table 6.8: Validated factor components: continuous improvement

• Enable the project team to participate in improvement • Conduct operational control • Analyse performance • Effectively and continuously learn from project experience • Engage in effective teamworking *

* New factor component emerging from the validation interview

6.4 Results of the validation interview analysis

This section presents the results of the validation interviews presented in sections 6.3.1–6.3.10. Commencing with change management, the interviewees highlighted the vital importance of planning ahead, as well as monitoring and record keeping to ensure continuity if, for example, the project manager suddenly becomes unavailable. Moreover, the need to ensure continuous improvement was affirmed in order to remain abreast of the competitors, who will all be implementing improvement measures to try to gain a competitive advantage. Also stressed was the importance of ensuring that the clients are fully informed of the implications of the design changes they may feel are necessary or desirable, so they will be absolutely clear about the implications for cost, time, and quality. Then, anticipating change was addressed in terms of considering the implications for the project lifecycle, learning from previous experiences of change, and negotiating change as a team to ensure full participation and to maximise the potential for a positive outcome (a new factor opponent emerging from the interviews, labelled 'Embrace the change as a team'). Essentially, the interviewees were fully committed to, and highly supportive of change management in their project, as well as its nine factor components, and thus the critical success factor was validated by the project managers.

In terms of evidence-based decision making, the interviewees rejected this as a critical success factor, citing the value of personal experience over evidence in making their decisions, and their reliance on intuition developed over many years in the role. It can be seen from the demographics of the interviewees in Table 6.1 that these project managers were all well established in their field, with an average of 34 years' experience, which may ultimately have led to their rejection of the reliance of evidence to drive decisions, and relinquishing control to a more contemporary approach of data-driven decision making. It could be speculated that younger project managers might have greater trust in harnessing data to inform or guide decisions, but nevertheless the highly experienced project managers in these validation interviews rejected the concept as a critical success factor, with important implications given the inclusion of evidence-based decision making as a QMP in ISO 9001:2015.

Client focus generated considerable responses from the interviewees, where they recognised the importance of understanding the clients' needs to maintain an effective service and enhance the potential for repeat work in the future, for which the likelihood is increased through ensuring that project quality remains high. Moreover, the importance of synergy between the project's team and the client's requirements was underscored as vital to inspire trust and confidence, since the client provides the finance for the project, and so their satisfaction both during the project and post-completion is vital. Therefore, the validation interviews confirmed client focus and its eight factor components as being critical success factors for the successful implementation of ISO 9001 and ensuring positive quality outcomes.

In terms of reducing the impact of non-standardisation in UK construction projects to support effective implementation of the ISO 9001 QMS, the interviewees rejected this concept as a critical success factor, suggesting that time spent focusing on the standardisation manuals could be better applied elsewhere in the project. Moreover, even with one interviewee being engaged on a heritage project, where the application of standard construction techniques and methodologies was not compatible with the unique nature of the building, this still did not elevate non-standardisation to the status of a critical success factor for quality in his view. Consequently, the project manager interviewees failed to validate non-standardisation and its five factor components, with this theme being firmly rejected as a critical success factor by this study.

Engagement of people generated considerable responses from the interviewees, which ranged from the need to conduct frequent discussions on issues that pose a threat to the project lifecycle, to engaging regularly with the numerous sub-contractors typically engaged on a contemporary construction project. The interviewees stressed the importance of open communication and being alert to the welfare of employees, as well as ensuring that teamwork is applied to address the quality issues that emerge. Meetings were held on a regular basis to allow thoughts to be voiced, approaches to be critiqued, and objectives to remain focused and on target. Essentially, there was strong validation of the findings that emerged from the quality management survey, with the interviewees confirming engagement with people as a critical success factor, alongside its nine factor components.

Regarding leadership, the interviewees expressed great certainty in terms of its importance to their role as a project manager. The applied practices such as leading by example, acknowledging and learning from their mistakes, recognising the importance of the leadership role, being a team player, and coaching others to promote their development (a new factor component labelled as 'coaching personnel to release their potential') underscored their belief of leadership being central to successfully carrying out their role and generating quality in the project. In confirming the 13 factor components that emerged from the quality management survey, and introducing one additional factor component, the interviewees both validated the critical success factor of leadership in terms of realising effective quality outcomes, and underscored its primacy in their perceptions of effectively and responsibly carrying out their role as project managers on UK construction sites.

In terms of the process approach, after confirming the finding from the quality management survey, the interviewees provided their own evidence to underpin this confirmation, which focused on the need to develop and follow plans and programmes of work; to apply processes that are evaluated, refined and taken forward to the next project; foreseeing risk and taking measures to address it; and exploiting the established processes to enable the integration of other trades and quality inspection to take place. Therefore, the interviewees were unequivocal in their agreement that the process approach represents a critical success factor for successful quality outcomes in the ISO 9001 quality context, providing concrete examples for how this manifested in their daily role as a project manager, and thus the process approach and its ten factor components were validated by the project managers.

Consideration of relationship management led the interviewees to consider how their interactions with the project stakeholders impacted on the quality outcomes of their projects. They confirmed the findings emerging from the investigation stage of the research, and addressed specifically how they strive to maintain high levels of communication to keep the stakeholders abreast of current developments in the project through regular meetings, sharing plans to foster transparency, recognising the central role of the project manager in managing relationships, negotiating change with stakeholders where there is uncertainty over the optimum approach, and finally ensuring that as project managers they remain accessible and approachable to maintain and develop effective stakeholder relationships. Consequently, there was firm agreement on the importance of the ten factor components that emerged from the quality management survey, and therefore relationship management was validated as a critical success factor for the effective implementation of the ISO 9001 QMS in UK construction projects.

Regarding skills and training, the consensus from the interviewees was that responsibility lay elsewhere. Following their review of the findings from the quality management survey, they cited a preference for recruiting fully skilled employees and reliance on the sub-contractors to ensure that all individuals they bring to site are fully equipped for the role they perform. The value of short courses was raised, in particular to engage with new products and equipment, but the preference was for employees to join the organisation ready to fulfil their role, and therefore skills and training, along with its eight factor components, was not validated by the interviewees as a critical success factor for ensuring enhanced outcomes in the context of the ISO 9001 QMS.

The final theme presented to the interviewees was continuous improvement, which generated considerable responses. There was acknowledgment of human error, and thus the fact that everyone from the project manager down has the potential to learn from their experiences and outcomes; the importance of regular team meetings to disseminate improvement measures; the need to assess performance to determine if the project is on target to achieve its aims; and to engage in effective teamworking (a new factor component emerging from the interviews) to promote successful outcomes and enhance productivity. Therefore, the project managers expressed strong views on the importance of continuous improvement in terms of quality, and thus it was validated as a critical success factor in terms of the ISO 9001 QMS, along with its 16 factor components.

Table 6.9 presents the findings of this research in terms of the final study outcomes, describing the process through which each of the critical success factors and factor component has been empirically identified and confirmed as being critical to the successful outcome of construction projects through supporting the effective implementation of the ISO 9001 QMS.

Table 6.9: The final critical success factors to support effective implementation of ISO 9001

No.	Factor	Factor component	Literature review	Questionnaire survey	Compare means test	Kendall's W test	Kruskal–Wallis test	Spearman correlation coefficient test	Validation interviews	Critical success factor
1	Change Management	Determine the needs and expectations of stakeholders	√	√	√	√	√	√	√	√
		Plan for change	√	√	√	√	√	√	√	√
		Monitor the needs and expectations of stakeholders	√	√	√	√	√	√	√	√
		Promote continual improvement	√	√	√	√	√	√	√	√
		Educate clients and other stakeholders on the negative outcomes of unnecessary change		√	√	√	√	√	√	√
		Predict the project environment and create contingency plans		√	√	√	√	√	√	√
		Anticipate change and address it effectively		√	√	√	√	√	√	√
		Prioritise and post-implement review of the change		√	√	√	√	√	√	√
		Embrace the change as a team							√	√
2	Client Focus	Understand the current clients' requirements	√	√	√	√	√	√	√	√
		Understand future clients' requirements	√	√	√	√	√	√	√	√
		Measure client satisfaction	√	√	√	√	√	√	√	√
		Ensure the project objectives match the client's requirements	√	√	√	√	√	√	√	√

		Ensure the project objectives match the client's expectations	√	√	√	√	√	√	√	√
		Clients are treated with respect and courtesy and empathise with their situation		√	√	√	√	√	√	√
		Do not leave the client waiting and let them know what is being done, commit to responding		√	√	√	√	√	√	√
		Conduct external measurements and surveys for the client's needs and engage seriously with the results		√	√	√	√	√	√	√
3	Engagement of People	Facilitate the open discussion of issues	√	√	√	√	√	√	√	√
		Facilitate the open discussion of barriers	√	√	√	√	√	√	√	√
		Enhance the motivation of personnel	√	√	√	√	√	√	√	√
		Ensure that employees' abilities are utilised	√	√	√	√	√	√	√	√
		Clarify work priorities and define the roles and responsibilities of the project team		√	√	√	√	√	√	√
		Carry out cyclical meetings to review the project status, to inform the team on progress and monitor for conflict		√	√	√	√	√	√	√
		Build trust between the project team and project leadership and between teams		√	√	√	√	√	√	√
		Involve people with ideas and encourage them to provide their perspectives and encourage groupthink		√	√	√	√	√	√	√
		Explore the project's components and discuss clearly the project's importance with staff members		√	√	√	√	√	√	√
4	Leadership	Establish a vision for the project	√	√	√	√	√	√	√	√
		Establish a pathway for the project	√	√	√	√	√	√	√	√
		Equip employees	√	√	√	√	√	√	√	√

		Create trust with employees	√	√	√	√	√	√	√	√
		Ensure commitment to the role	√	√	√	√	√	√	√	√
		Ensure commitment to policy	√	√	√	√	√	√	√	√
		Ensure responsibility to project partners	√	√	√	√	√	√	√	√
		Identify challenging targets	√	√	√	√	√	√	√	√
		Ensure the efficient use of resources	√	√	√	√	√	√	√	√
		The leadership must acquire complete awareness of the project's requirements		√	√	√	√	√	√	√
		Emphasise motivation and team building to allow different members to collaborate		√	√	√	√	√	√	√
		Conduct a study for the project with the team and the stakeholders during the planning phase to comprehend project requirements		√	√	√	√	√	√	√
		Understand how to prioritise and the goals, objectives and requirements		√	√	√	√	√	√	√
		Coach personnel to release their potential							√	√
		Manage activities as processes	√	√	√	√	√	√	√	√
		Conduct audits of processes	√		√	√	√	√	√	√
		Take action to address risk	√	√	√	√	√	√	√	√
5	**Process Approach**	**Take action to exploit opportunity**	√	√	√	√	√	√	√	√
		Gauge the feasibility of activities	√	√	√	√	√	√	√	√
		Determine links between activities	√	√	√	√	√	√	√	√
		Manage and monitor every process and control, measure the results, and report		√	√	√	√	√	√	√

		Evaluate and improve the processes is a constant, systematic and repetitive procedure		√	√	√	√	√	√	√
		Ensure the appropriate methodologies, resources, personnel and tools are available for each planning process		√	√	√	√	√	√	√
		Assure that all those involved in the project have an appropriate understanding of the process level		√	√	√	√	√	√	√
6	**Relationship Management**	**Share information with stakeholders**	√	√	√	√	√	√	√	√
		Share plans with stakeholders	√	√	√	√	√	√	√	√
		Cooperate in the development of activities	√	√	√	√	√	√	√	√
		Establish effective intra-project-partner cooperation	√	√	√	√	√	√	√	√
		Establish short-term relationships	√	√	√	√	√	√	√	√
		Establish long-term relationships	√	√	√	√	√	√	√	√
		Engage stakeholders effectively and frequently		√	√	√	√	√	√	√
		Ensure that all parties comprehend the overarching project aims		√	√	√	√	√	√	√
		Promote good stakeholder relationships		√	√	√	√	√	√	√
		Assess the stakeholders' behaviour and needs		√	√	√	√	√	√	√
7	**Continuous Improvement**	**Provide resources for continuous improvement**	√	√	√	√	√	√	√	√
		Manage resources for continuous improvement	√	√	√	√	√	√	√	√
		Provide documentation for corrective action	√	√	√	√	√	√	√	√
		Enable the project team to participate in improvement	√	√	√	√	√	√	√	√
		Conduct operational planning	√	√	√	√	√	√	√	√

		Conduct operational control	√	√	√	√	√	√	√	√
		Identify the requirements	√	√	√	√	√	√	√	√
		Measure improvement consistently	√	√	√	√	√	√	√	√
		Analyse performance	√	√	√	√	√	√	√	√
		Develop a reward system	√	√	√	√	√	√	√	√
		Effectively and continuously learn from project experience		√	√	√	√	√	√	√
		Dissemination of internal awareness on continuous improvement		√	√	√	√	√	√	√
		Ensure the adequate documentation of organisational responsibilities on the project		√	√	√	√	√	√	√
		Listen to and manage relationships with clients and other stakeholders		√	√	√	√	√	√	√
		Performance measurement at the processes level		√	√	√	√	√	√	√
		Engage in effective teamworking							√	√

6.5 Conclusion

This chapter presented the analysis of the qualitative responses from the interviews of six project managers in terms of validating the critical success factors that support the effective implementation of the ISO 9001 QMS in UK construction projects. The interview responses were presented as verbatim excerpts and compared with the literature and the findings from the survey presented in Chapter 5 in order to explain how and why these critical success factors and factor components manifest in the everyday reality of construction project managers in the UK.

The six interviewees' experience ranged from 26 to 46 years, and thus they had a wealth of knowledge to offer. The analysis of this rich data led to the agreement of the findings from the quality management survey and valuable insight on 33 factor components in terms of why these are important in relation to successful project outcomes and how they appear on the ground during project management. Six of the confirmed critical success factors echo those presented in the literature as QMPs in ISO 9001:2015, namely client focus, engagement of people, leadership, the process approach, relationship management and continuous improvement (Fonseca and Domingues, 2017b), with change management found to be an additional critical success factor for the successful implementation of the ISO 9001 QMS in UK construction projects. Furthermore, the three critical success factors of evidence-based decision-making, reduce the impact of non-standardisation, and skills and training rejected in Chapter 5 were also rejected as critical success factors by the interviewees, with the rejection of evidence-based decision-making representing a particularly surprising finding of this research given its inclusion in ISO 9001:2015 as a QMP. Three new factor components emerged from the interviews: i) embrace the change as a team (Change management), coach personnel to release their potential (Leadership), and engage in effective teamworking (Continuous improvement). A final summary of the critical success factors emerging from this research in terms of supporting the effective implementation of the ISO 9001 QMS in UK construction projects was presented in Table 6.9, comprising of 7 critical success factors and 76 factor components.

With the validation of the questionnaire data now complete, the next chapter concludes the findings from the analysis presented in Chapter 5 and Chapter 6, in conjunction with the literature reviewed in Chapter 2 and Chapter 3.

Chapter 7

Conclusion

7.1 Introduction

The aim of this research was to investigate the critical success factors for effective ISO 9001 QMS implementation in UK construction projects through the perceptions of UK construction project managers in order to enhance project performance and increase the likelihood of a successful outcome. The research question established for this study was as follows: What are the critical success factors for the implementation of the ISO 9001 QMS to achieve successful outcomes in UK construction projects? Chapter 1 presented the study's introduction, including the justification for the research, the aim and the objectives, as well as the thesis structure. A review of the literature was then conducted in Chapter 2 and Chapter 3 to provide a foundation for this study in terms of UK construction and the ISO 9001 QMS as it is applied in the construction industry at large, which led to the emergence of a series of critical success factors and associated factor components. Chapter 4 discussed the research design methodology that was employed in this thesis to ensure that the aim and objectives of this study could be achieved in terms of investigating and then validating the findings that emerged from the literature. Chapter 5 moved on to explore the results from the quality management survey, which were distributed to UK construction project managers from companies engaged as contractors whom were both ISO 9001 certified and implemented the quality system in their projects, to ensure their relevance to the research focus. The results of this analysis were then validated in Chapter 6 through qualitative semi-structured interviews with six UK-based project managers from construction companies engaged as contractors, whose companies were also ISO 9001 certified and implemented the QMS in their projects.

The structure of this chapter is as follows. First, the synthesis of the research objectives is presented, followed by a summary of the research findings in terms of the outcomes of the ten critical success factors that emerged from the literature review and were examined in this research, with the conclusion of the research then stated. Following this, the research methodology and approach are critiqued to determine where the strengths lie, where challenges were encountered, and ultimately whether the requirements of the study could be fulfilled in terms of the aim and objectives. Then, the study's limitations, the contribution to knowledge, the research novelty, and the study's recommendations are presented. Finally, a final conclusion of the study is made to draw the thesis to a close.

7.2 Synthesis of the research objectives

To achieve the aim of this study, namely to identify the critical success factors that support the effective implementation of the ISO 9001 QMS in UK construction projects in order to improve project performance and increase the likelihood of a successful outcome, four objectives were established, as presented in section 1.4. The first objective was to conduct a review of the literature in the field to gain a theoretical understanding of the UK construction industry, UK construction projects and the ISO 9001 QMS, whilst the second objective was to carry out a review of the literature in the field to determine the barriers to effective implementation of the ISO 9001 QMS in construction projects; both of these objectives were achieved through a comprehensive review of the literature (i.e. journal articles, books, conference papers, websites, reports and ISO manuals) in Chapter 2 and Chapter 3. The third objective was to develop critical success factors for effective implementation of the ISO 9001 QMS in UK construction projects, which was reached through the analysis of the data gathered via the quality management survey, as described in Chapter 5. The final objective was to validate the developed critical success factors for effective ISO 9001 QMS implementation in UK construction projects, whereby the interviews with six project managers presented in Chapter 6 ensured that this objective was accomplished. Sections 7.2.1–7.2.5 below discuss in more detail how these four objectives were achieved, and briefly outline the respective results.

7.2.1 Objective one: conduct a review of the literature in the field to gain a theoretical understanding of the UK construction industry, UK construction projects and the ISO 9001 QMS

In terms of gaining a theoretical understanding of the UK construction industry and UK construction projects, the characteristics of a construction project were established in Chapter 2, where project management was found to be an essential function to meet the various deadlines of a construction project, as well as to meet the agreed costs so that the project's objectives can be achieved efficiently and effectively. Then, the chapter considered the UK construction industry in terms of its strength, scope and contribution to the UK economy, before the project’s delivery, parties and project management were investigated, with primary research cited to present a complete and contemporary view of field. Then, the current status of ISO 9001 QMS and its implementation in construction projects was investigated in Chapter 3. Quality management was identified as a key project management component, supporting the delivery of the project on schedule, within the cost parameters, and featuring acceptable quality (see Figure 3.1); with quality being defined as the completed project's ability to meet the specified or implied requirements, which in the case of construction relates to unique outcomes as opposed to the repetitive processes found in the manufacturing and services sectors. The management of quality was thus deemed to be a vital project management role, whereby the project's growth and continued improvement is heavily reliant upon ensuring appropriate quality management mechanisms. The history and development of QMSs were explored, as well as the ISO 9000 family of standards, whereby ISO 9001 was found to be an internationally recognised standard for quality management, with certification often included as a contractual obligation. To demonstrate the evolution of QMS over time, changes to the structure and clauses provided by ISO 9001:2008 and ISO 9001:2015 were described (see Table 3.1). The relationship between ISO and procurement was also considered, with quality becoming a vital component due to the competitive and dynamic environment that places price under increasing pressure (Cârstea et al., 2014). Finally, the internal benefits of the ISO 9001 QMS were found to include increased efficiency, process control, productivity, and the quality of products and services, while the external benefits were reported as access to new markets, increased sales, and enhanced productivity (Manders and de Vries, 2012). Through the literature review, the theoretical knowledge and understanding of the current status of the UK construction industry and UK construction projects were determined, while in terms of ISO 9001 QMS implementation in construction projects, this was thus acquired by establishing its origins, development over time, application in various contexts, and function in terms of the management of quality to promote successful project outcomes; hence, objective one was achieved.

7.2.2 Objective two: carry out a review of the literature in the field to determine the barriers to the effective implementation of the ISO 9001 QMS in construction projects

The most common challenges affecting the effective implementation of the ISO 9001 QMS in construction projects were explored by means of undertaking a review of the literature in Chapter 2 and comprised of: changing scope, risk management, stakeholder management, unrealistic expectations, and stakeholder indifference (see section 2.5). The most common barriers to the effective implementation of the ISO 9001 QMS in construction projects were found to be threats to: effective change management, client focus, leadership, non-standardisation, skills and training, and relationship management (see section 3.8). From these challenges and barriers, as well as the wider literature review in Chapter 3, ten critical success factors emerged that were deemed to be critical to the effective implementation of the ISO 9001 QMS in construction projects (see Table 3.4). Therefore, through the literature review that explored the challenges and barriers to effective ISO 9001 implementation, objective two was achieved and established the theoretical foundation for the investigation to take place through the quality management survey to determine which critical success factors are applicable in UK construction projects.

7.2.3 Objective three: develop critical success factors for effective implementation of the ISO 9001 QMS in UK construction projects

To achieve this objective, data collection was conducted via the quality management survey with UK-based project managers in order to shed light on their views of successful quality management implementation through the ISO 9001 QMS in the UK context. After the deployment of the quality management survey (Chapter 5), which was developed from the literature reviewed in Chapter 2 and Chapter 3, the data that emerged from the 124 completed instruments confirmed that quality management in UK construction projects offers significant potential in terms of realising successful outcomes (see section 5.6.2), whereby the overwhelming majority of the respondents (n=117) confirmed that their organisations were both ISO 9001 certified (see Table 5.3) *and* applied the QMS in their construction projects in practice (see Table 5.5), supporting the notion that a QMS is vital to ensure construction companies produce outcomes with added value at consistently high quality. The collected data was extensive and robust in terms of allowing the critical success factors to be explored in detail. Overall, it is reasonable to conclude that the project managers had a good understanding of the ISO 9001 QMS and expressed clear opinions in terms of their agreement or disagreement with the components and factors measured, while extending these through additional comments. At the conclusion of the investigation stage, where the data had been collected and analysed, it was evident that there was agreement with the QMS literature regarding six of the current ISO 9001 QMPs, suggesting strong alignment with the investigative findings, while one further critical success factor was also found to warrant consideration as a QMP, namely. change management. Nevertheless, the analysis led to the provisional rejection of three critical success factors, one of which is an established ISO 9001 QMP (i.e. evidence-based decision-making), and thus validation was necessary through the interviews conducted in Chapter 6 of this research. Therefore, through the provisional findings that resulted from exploring the perspectives of project managers engaged with UK construction projects in terms of those factors critical for their projects' success, objective three of this research was achieved.

7.2.4 Objective four: validate the developed critical success factors for effective ISO 9001 QMS implementation in UK construction projects

Six interviews were conducted with construction project managers during the validation stage of the research, with the results presented in Chapter 6. There was consistent agreement with the investigation's findings of the importance of client focus, engagement of people, leadership, the process approach, relationship management and continuous improvement (see sections 6.3.3, 6.3.5–6.3.8 and 6.3.10, respectively) as critical success factors for the successful implementation of the ISO 9001 QMS in UK construction projects, echoing the literature and supporting the revised ISO 9001 QMPs in the 2015 version of the standard (Fonseca and Domingues, 2017b). Change management (see section 6.3.1) was found to be an additional critical success factor, and therefore should be considered for potential inclusion as an additional QMP in the ISO 9001 QMS, pending confirmation in the literature through future work. The validation process confirmed the rejection of evidence-based decision-making, reduce the impact of non-standardisation, and skills and training as critical success factors (see sections 6.3.2, 6.3.4 and 6.3.9, respectively) in the UK construction context. In terms of evidence-based decision-making, this was a surprising finding given the support in the literature and the most current ISO 9001:2015 version, whereby it presently stands as one of the seven QMPs. Following the validation stage, a final set of 7 critical success factors with 76 associated factor components was confirmed as being critical to the successful implementation of the ISO 9001 QMS in UK construction projects, as presented in Table 6.9, which thus fulfils the final objective of this study.

7.3 Research findings

This section summarises the findings of the research following the literature reviewed in Chapter 2 and Chapter 3, the provisional findings emerging from the questionnaire investigation in Chapter 5, and the validation of these results conducted through the interviews with project managers in Chapter 6.

7.3.1 Change management

The findings of this study emerging from the literature review, questionnaire investigation and validation interviews with project managers confirm that change management is deemed to be a critical success factor for the successful implementation of the ISO 9001 QMS in UK construction projects, comprising of nine factor components that include planning for change, informing clients of the implications of change, how and when measures should be implemented, appraising the needs and expectations of the stakeholders, and conducting post-change review in order to ensure the effective management of changes that inevitably occur in such complex and time-intensive projects. This confirms the prevailing view in the literature that construction projects are typically unique projects that have become increasingly complex and technical in terms of the design, the construction techniques, and the contractual relationships (Rumane, 2018), and therefore the incidence of change and its complexity is ever present in the modern construction project. This research thus concurs with ISO 9001:2015, which correctly focuses on the importance of change management and offers guidance in terms of measures that can be applied to allow organisations to plan and then modify the QMS to facilitate the timely reaction to changes in circumstances, the client's requirements, the organisational strategies, the competition and the regulatory requirements. Therefore, the findings present strong evidence to support the continued emphasis on change management as a critical success factor for successful quality outcomes in UK construction projects, and the study encourages its continued inclusion in future editions of the ISO 9001 QMS, potentially as a QMP.

7.3.2 Evidence-based decision-making

Evidence-based decision-making is encouraged in ISO 9001:2015, with the rationale that those decisions grounded in the analysis and evaluation of data/ information have a greater likelihood of producing the desired outcomes (Hoyle, 2018). In this study, however, evidence-based decision-making was rejected as a critical success factor, both in the statistical analysis in Chapter 5 (see section 5.10), and by the interviewees at the validation stage, where the latter expressed agreement with the ISO 9001:2008 approach of more factual rather than evidential decision-making. This represents a surprising finding of this study, given the support in the literature and the most current ISO 9001:2015 version, where evidence-based decision-making comprises one of the seven QMPs. Therefore, this finding raises questions over a potential disconnect between the ISO planners and contributors, and the perceptions of project managers on the ground in UK construction projects. In order address this issue, the researcher encourages urgent investigation into the appropriateness of evidence-based decision-making as a specific focus of the ISO 9001 series moving forward, and whether this UK-based rejection is echoed in the wider geographical field. The results of this research would need to be concluded prior to the release of the next version of ISO 9001, to allow any required updates or amendments to be implemented accordingly.

7.3.3 Client focus

In this study, client focus was confirmed as a critical success factor by the construction project managers at the investigation and validation stages, comprising of eight factor components that include awareness of the client's requirements and expectations, ensuring these are met, the measurement of satisfaction, and treating clients respectfully. Five of these factor components emerged from the literature, and an additional three were introduced through the quality management survey. There was strong agreement on the importance of this critical success factor at all stages of the study in terms of its relevance to the successful implementation of the ISO 9001 QMS in UK construction projects, from the empirical research in the literature, to the responses of the project managers in the survey, and finally the validation interviews. Client focus remains one of the established QMPs following the revision from ISO 9001:2008 to ISO 9001:2015 (Fonseca and Domingues, 2017b), and the findings of this study underscore its importance in terms of ensuring that the client's needs and expectations are fulfilled, enhancing the likelihood of perceptions of project success, and the consequential favourable impact that this will have on client loyalty and the reputation of the organisation. Therefore, this study affirms the importance of client focus through the robust evidence of project managers' perceptions as a critical success factor for successful project outcomes, with the need for its continued inclusion and development in future editions of ISO 9001.

7.3.4 Non-standardisation

There was a mixed response to the notion of non-standardisation in the questionnaire, with two of the three factor components rejected, and two more introduced through the project managers' qualitative comments. Then, the critical success factor was rejected by the compare means test. In the validation stage, the interviewees did not commit to the importance of non-standardisation as a critical success factor. Therefore, with the non-standardisation critical success factor failing the compare means test, two of the three factor components being rejected through the questionnaire and the interviewees casting doubt on the overall benefit of the critical success factor as a whole, non-standardisation and its five factor components were rejected by this research.

Consequently, despite construction projects being typified by their unique and non-repetitive nature (Haupt and Whiteman, 2004), as well as their diversity in terms of the forms, shapes, and types (Bawane, 2017), this study finds that UK-based project managers do not view non-standardisation as a significant factor to focus on in terms of project success. In fact, while the participants did accept that construction projects tend to be unique, they confirmed the strong drive towards the standardisation of components and practices to minimise the impact on the quality outcomes of the project. Therefore, this research concludes that the impact of non-standardisation has been negated by modern practices and no longer presents a significant threat to quality in UK construction project contexts, with no evidence emerging to justify a recommendation for non-standardisation to be considered for inclusion in future editions of ISO 9001.

7.3.5 Engagement of people

Engagement of people proved to be a popular theme in the questionnaires and interviews, with the project managers making significant contributions in terms of their perceptions and beliefs in this domain. The findings that resulted from the literature review, questionnaire investigation and validation interviews confirm that engagement of people is deemed to be a critical success factor for the successful implementation of the ISO 9001 QMS in UK construction projects, alongside its nine associated factor components that focus on motivation, open discussion, utilising ability, building trust, and clearly defining roles. Evidently, for project managers of contemporary construction projects, communication and the resolution of issues that arise represent an important facet of their role. This importance is reflected in the engagement of people QMP, where there has been a shift from the passive 'involvement of people' in the ISO 9001:2008 to the more active 'engagement of people' in ISO 9001:2015 (Fonseca and Domingues, 2017b), with this change in terminology implying stronger participation as well as the focus on competence. This study's findings agree with the elevated emphasis on 'engagement' rather than the less dynamic 'involvement' in ISO 9001:2015, as the project manager is located centrally to the myriad of contactors, employees and stakeholders involved in modern construction projects. Therefore, the project manager must strive to ensure that all parties within the organisation are empowered and engaged in order to promote the cohesion and cooperation that lead to successful quality outcomes. Consequently, this research presents strong evidence of engagement with people as a critical success factor for successful quality outcomes in UK construction projects and supports the continued inclusion of the QMP in future editions of ISO 9001.

7.3.6 Leadership

Leadership was another popular theme for the participants in this research, with the respondents to the quality management survey agreeing with the nine factor components that emerged from the literature, and supplementing these with an additional four, which were all validated in the interviews, along with the introduction of one additional factor component. The focus on these factor components includes the creation of trust, establishing a project vision, maintaining commitment to the role, being able to prioritise, and coaching personnel to achieve their full potential. The finding of this research is therefore that leadership is confirmed as a critical success factor for the successful implementation of the ISO 9001 QMS in UK construction projects. Clearly, project managers are located within the hierarchy of their organisation, and need to exemplify leadership both to ensure that their superiors have confidence in their ability to fulfil their role's responsibilities, while also inspiring confidence in their subordinates who feel valued and supported. Essentially, the organisation's culture, motivation and vision emerge from the leadership, with leaders creating the vision and motivation through their decision-making and action, which consequently drives the motivation of the personnel (Hoyle, 2018). This study thus concurs with the importance of the leadership QMP found in ISO 9001:2015, and provides strong evidence for its continued presence as a key factor for successful quality outcomes in future editions of ISO 9001.

7.3.7 Process approach

The research participants expressed a strong interest in the process approach, with the six factor components that emerged from the literature review being agreed upon and supplemented with an additional four. All ten of these factor components, that include conducting audits of processes, taking action to address risk and opportunity, identifying the relationships between activities, and ensuring the required level of process awareness, were validated and underscore the importance of the process approach to the contemporary project manager. The management of processes has seen increased attention in the literature, with the ISO 9000 family now firmly grounded in the PDCA methodology (see Figure 3.5) (ISO, 2016a). This study finds that the methodological and iterative cycle promoted in the process approach QMP has great importance in terms of (i) how related processes can be managed, (ii) whether the organisational planning resulted in perceived quality and client satisfaction, and (iii) what actions can be implemented to continue to improve the processes and results. Therefore, this study finds the process approach to be a critical success factor for successful quality outcomes in UK construction projects and again provides strong evidence for its continued inclusion as a QMP in future editions of the ISO 9001.

7.3.8 Relationship management

In terms of relationship management, the theme generated considerable interest, both in the level of additional comments in the quality management survey, and the depth of discussion that occurred in the validation interviews. The management of relationships was clearly central to the role of the project manager respondents in this research, whereby the importance of cultivating and maintaining good relationships with stakeholders was perceived to be paramount, and an essential criterion for contributing to positive quality outcomes. Following the investigation and validation stages, relationship management was thus confirmed as a critical success factor for the effective implementation of the ISO 9001 QMS in UK construction projects to ensure successful outcomes, along with its ten associated factor components that include sharing information and plans with stakeholders, promoting cooperation, developing short- and long-term relationships, and promoting robust stakeholder relationships. This study thus agrees with the decision to elevate 'mutually beneficial supplier relationships' under ISO 9001:2008 to the relationship management QMP that features in ISO 9001:2015 (Fonseca, 2015), finding that effective relationships continue to be vital for positive quality outcomes in contemporary construction projects with the myriad of stakeholders that are typically involved.

7.3.9 Skills and training

In terms of skills and training as a critical success factor, of the five factor components that arose through the literature review, only three were agreed upon in the quality management survey responses. For example, the participants disagreed with the notion of training personnel in terms of quality, teaching the quality aims, and enabling learning, thus implying that responsibilities for such training are either deemed unnecessary, or the responsibility of others such as the sub-contracting firms mentioned in the validation interviews. The critical success factor as whole failed the compare means test (see Table 5.29), and none of the factor components were validated by the interviewed project managers, with the general consensus again being that skills and training are the responsibility of the sub-contractor. Evidently, the focus on the these project managers' construction sites is on the personnel arriving fully equipped to carry out their role, reflecting the fragmented contractual nature of contemporary construction with a multitude of sub-contractors engaged in their particular specialist tasks, and the main contractor managing their progress, as opposed to the main contractor being their direct employer. Therefore, the skills and training critical success factor and its eight associated factor components are confirmed as being rejected as a critical success factor for the effective implementation of the ISO 9001 QMS in UK construction projects to ensure a successful outcome, with no rationale found for the recommendation of its inclusion in future editions of ISO 9001.

7.3.10 Continuous improvement

The notion of continuous improvement was a popular theme, with fifteen factor components emerging from the quality management survey, which were all agreed upon by the project managers in the validation interviews, and supplemented by an additional component, thus resulting in sixteen factor components in total, which include ensuring that sufficient resources are available, conducting operational planning and control, analysing performance and measuring improvement. The continuous improvement QMP defines the long-term objectives of the organisation in terms of performance, whereby an approach should be applied that addresses the entire organisation (Manders et al., 2016), with the project managers in this research being unified in terms of its relevance and importance to successful quality outcomes. Continuous improvement was thus asserted in this research as being vital to stay ahead of the competition, ensure client loyalty and to promote the ongoing success of the organisation moving forward. Therefore, after passing through the investigation and validation stages, relationship management was confirmed as a critical success factor for the effective implementation of the ISO 9001:2015 QMS in UK construction projects to ensure a successful outcome, with this study encouraging its continued emphasis in future editions of ISO 9001 to ensure that the vital objective of improvement continues to be recognised and addressed.

7.4 Conclusions of the study

The aim of this study was to investigate the critical success factors for effective ISO 9001 QMS implementation in UK construction projects through the perceptions of UK construction project managers in order to improve the project's performance and the likelihood of a successful outcome.

Through the literature review, ten critical success factors and their associated factor components were identified:

1. Change Management (4 factor components)
2. Evidence-Based Decision-Making (11 factor components)
3. Client Focus (7 factor components)
4. Non-Standardisation (3 factor components)
5. Engagement of People (7 factor components)
6. Leadership (12 factor components)
7. Process Approach (11 factor components)
8. Relationship Management (9 factor components)
9. Skills and Training (7 factor components)
10. Continuous Improvement (11 factor components)

The quality management survey was then developed to gather data from project managers from UK construction companies engaged as contractors, which were then statistically analysed and passed through a series of tests, after which seven critical success factors were identified and three rejected, with a number of additional factor components being introduced by the project manager respondents (see Table 7.1).

Table 7.1: Provisional findings after the quality management survey data analysis

Critical success factor	Factor components	Provisional status
Change Management	8	Accepted
Evidence-Based Decision-Making	14	Rejected
Client Focus	8	Accepted
Non-Standardisation	5	Rejected
Engagement of People	9	Accepted
Leadership	13	Accepted
The Process Approach	10	Accepted
Relationship Management	10	Accepted
Skills & Training	8	Rejected
Continuous Improvement	15	Accepted

These provisional findings were then validated through interviews with project managers from UK construction companies engaged as contractors who reviewed and discussed the outcomes of the questionnaire, leading to the confirmation of the 7 aforementioned critical success factors and their 73 factor components as being important to support effective implementation of the ISO 9001 QMS in UK construction projects, with 3 new factor components being introduced. The study's findings are thus summarised in Table 7.2 below.

Table 7.2: Validated findings of the study

Critical success factor	Factor components	Final status
Change Management	9*	Confirmed
Evidence-Based Decision-Making	14	Rejected
Client Focus	8	Confirmed
Non-Standardisation	5	Rejected
Engagement of People	9	Confirmed
Leadership	14*	Confirmed
The Process Approach	10	Confirmed
Relationship Management	10	Confirmed
Skills & Training	8	Rejected
Continuous Improvement	16*	Confirmed

NOTE: * refers to a new factor component introduced through the interviews at the validation stage.

Therefore, the research aim of investigating the critical success factors for effective ISO 9001 QMS implementation in UK construction projects through the perceptions of UK construction project managers has been achieved through fulfilling the objectives stated in section 1.4 of (i) gaining theoretical knowledge and understanding of the UK construction industry and projects (see Chapter 2), and the current status of ISO 9001 QMS implementation in construction projects (see Chapter 3); (ii) identifying the barriers to the ISO 9001 QMS's effective implementation in construction projects (see Chapter 2 and Chapter 3); (iii) identifying critical success factors for the effective implementation of the ISO 9001 QMS in UK construction projects (see Chapter 5); and (iv) validating and developing the critical success factors for effective ISO 9001 QMS implementation in UK construction projects (see Chapter 6). The final list of critical success factors and factor components, representing the outcome of this study, can be found in Chapter 6 (Table 6.9).

7.5 Research methodology critique

The methodology applied in this study enabled the successful collection of data on the phenomenon of focus, that is, the effective implementation of the ISO 9001 QMS in UK construction projects. Initially, the related literature was identified in Chapter 2 (UK construction) and Chapter 3 (ISO 9001), including the theorical background and barriers to effective ISO 9001 implementation, which led to a series of critical success factors being identified. The ISO QMS 9001 was also explored in Chapter 3 in terms of (i) its evolution from a procedural-based emphasis in 1987 to its current version in 2015, where the focus is placed on the risks and opportunities that present, and (ii) a specific examination of the changes in structure and clauses seen between the 2008 and 2015 versions of the standard (see section 3.5). Moreover, the seven current ISO 9001 QMPs were explored (see sections 3.4.2.1–3.4.2.7), as well as the advantages of using the QMS in terms of the implementation of the standard and being ISO 9001 certified (see section 3.6).

The data collection process began with the development and deployment of a quantitative quality management survey (Chapter 5). Analysis of the resulting data led to provisional findings which were then appraised and validated through semi-structured interviews with six project managers using the same interview schedule and sequence of questions (Chapter 6), which helped to reduce error due to interviewer variability (Bryman, 2012). The researcher determined that no specific sector of the construction industry would be targeted specifically, with the data being collected from project managers engaged in general project contexts. The rationale for this choice was that large construction companies in the modern era are frequently engaged in a broad range of project types (e.g. see Table 6.1), with the addressing of quality issues to increase client satisfaction, completion on-budget and on-time being relevant to all construction project contexts. Nevertheless, there is scope to explore how the quality management issues that arise may differ in specific project contexts, which could be considered in future work (see section 7.9).

Challenges were encountered during the interviewing process due to the dynamic nature of busy construction sites, the demands of the modern project manager, and the time constraints of the researcher. Nevertheless, the interviewees were committed and interested in the research topic, and rich data was gathered to enable the validation of the findings from the quality management survey. Content analysis was applied to the qualitative data emerging from the semi-structured interviews, which offered the benefits of being reproducible and for potential follow-ups to be conducted, while representing an objective method of analysis (Bryman, 2012). The ability to validate the findings from the quality management survey through the qualitative responses to the interview questions echoes what Yin (2016) referred to as the sequential combination of quantitative and qualitative components of a study, thus enhancing the consistency of the data through its collection from several sources. On reflection, the research philosophy and design applied in this study have enabled the study's aim to be fulfilled by facilitating a review of the literature that led to an initial series of critical success factors to be established, with data on these then collected, analysed and validated, resulting in seven critical success factors being identified as the final outcome of this research.

7.6 Research limitations

During this investigation, a number of challenges were encountered that resulted in limitations to the findings of this study:

- The relatively low response rate to the questionnaire has limited the generalisability of the results to some extent, although the ideal sample size is not easy to determine (Robson and McCartan, 2016).
- Additional and more extensive interviews could have been conducted to gather a larger body of qualitative data for validation purposes; however, as an independent researcher there are financial and time constraints to how much data can be feasibly collected and analysed (Saunders et al., 2016).
- Securing validation interviews was a challenging process. Some appointments were cancelled, while some interviewees were clearly under time pressure due to the pressing demands of the contemporary project manager. Furthermore, the interviews were conducted in the workplace of a busy construction project, and some project managers

became distracted, leading to a reduction in the richness of the data they were able to provide.

- Only semi-structured interviews were conducted at the validation stage, and more open unstructured interviews or focus groups may have broadened the scope of the responses and led to new insights into the acceptance and rejection of the critical success factors and/ or factor components, as well as their relevance to the project managers in their workplace environment.
- No female perspectives were included in the project managers interviewed, nor was gender distribution recorded in the quality management survey, or the influence of gender on quality management practices explored in the literature. Despite being a traditionally male-dominated landscape, the modern era is seeing more females entering the domain of construction either as physical operatives, or as management professionals. Whether this lack of gender focus would have influenced the findings of this study remains unclear, but the fact that it was not considered represents a limitation of this study.
- This study focused on UK-based construction project managers only, and thus the findings may be less generalisable to non-UK settings due to the specific national characteristics, behaviours and environment. Moreover, as the survey did not determine the project types focused on by the respondents' organisations (e.g. historical restoration, high-rise refurbishment, low-rise residential new build, healthcare settings, residential, etc), it was not possible to analyse the data from this perspective.
- This study identified critical success factors for the successful implementation of the ISO 9001 QMS in the UK construction in 2019; therefore, there is the possibility that some of these success factors may become invalid at a future date, as per the evidence-based decision-making rejected by this research, and so this study may need to be repeated periodically to ensure its relevance to the changing nature of the construction environment.

7.7 Contribution to knowledge

This study contributes to the bodies of theoretical and practical knowledge in the fields of project management and quality management.

In terms of the contribution to theory, this study supplements the limited existing research to ensure more effective implementation of the ISO 9001 QMS in construction projects, whereby the outcomes of this investigation contribute towards the enrichment of the literature in this domain, particularly in the UK context. Moreover, it directly confronts the poor levels of satisfaction with the service provision and the final quality outcome frequently expressed by construction industry clients (Proverbs et al., 2018). The research addresses this through an in-depth review of the existing literature, together with the analysis of data drawn from project managers in the field, in order to illuminate critical success factors for the effective implementation of the ISO 9001 QMS in UK construction projects, thus enhancing current knowledge and understanding, and promoting such projects' long-term success. Moreover, from the perspective of quality management research, this study's findings offer fresh insight into the implementation of the ISO 9001 QMS by project managers, shedding light on its effectiveness and efficiency on the ground in UK construction projects, thus offering valuable feedback to the contributors of ISO 9001's development in terms of where its strength are perceived and improvements can be made. Furthermore, there is the potential for the findings from this study (i.e. the identified critical success factors and factor components) to be embraced by other QMSs, and particularly those that have the flexibility to harness the strengths from other quality management approaches, such as ISO 21500 (see section 3.4). In summary, this study serves to enrich the current theory with critical contributions gathered from the perceptions of project managers engaged in the field of contemporary UK construction projects.

Regarding the contributions to practice, challenges present during the management of construction projects that may lead to project failure, delays, running over budget or unsatisfactory quality (Schwalbe, 2015). It is believed that this study's findings can offer clarity on ISO 9001 quality management implementation in the UK context, providing guidance for quality management practitioners in the field engaged with construction projects in order to ensure more effective outcomes, which will lead to enhanced organisational reputation in terms of the quality achieved whilst keeping costs competitive, thus ensuring that ISO 9001 has a positive influence on the procurement process in terms of the perceived benefits it can offer (see section 3.6.1). Adhering to the findings resulting from this study should lead to the improved meeting of project deadlines through the reduction of the need for re-work, and thus, an overall increase in the project's efficiency due to the more effective implementation of ISO 9001, as per the intended benefits (see Figure 3.6).

7.8 Research novelty

The originality of this work begins with its analysis of the literature to identity ten critical success factors for the effective implementation of QMSs, as presented in Table 3.4. These critical success factors and their associated factor components were then confirmed, rejected, or extended based on the findings from the quality management survey, with these findings then validated by qualitative interviews with six project managers from UK construction companies engaged as contractors. Therefore, the research novelty is in terms of the identification of (i) the critical success factors for successful QMS implementation in general, as emerged from the literature; and (ii) the critical success factors and factor components identified by this research to enable the successful implementation of the ISO 9001 QMS in UK construction project contexts in particular, as emerged from the survey and interviews.

7.9 Research recommendations

This section presents suggestions for future work to be conducted to further investigate and extend the findings from this research:

- Further research is recommended in different national contexts in the western sphere in order to enable comparisons to be drawn and greater understanding of the influence of national characteristics, policies, and behaviours on the implementation of the ISO 9001 QMS in construction projects.
- Observational research within the quality management team during the procurement process would be helpful to explore in a greater depth how competitive pressures are balanced with the need to ensure that quality is not compromised, and that client satisfaction with the project outcome is achieved.

- Longitudinal research over the project lifecycle through case study is recommended to investigate the implementation of the ISO 9001 QMS and how challenges that arise are addressed.
- Further investigation of the evidence-based decision-making included in ISO 9001:2015 but rejected by the study is recommended in order to establish whether it should be removed as a QMP and replaced by change management, as per the findings from this study.
- Since the importance of critical success factors may change over time, periodic research may be necessary to determine whether those identified in this study remain valid or differ in the future.
- With this study's lens of focus placed on the general project context, it would be of interest to explore in a more granular manner how quality issues may differ within different project contexts (e.g. new build, heritage, public and private sector). Therefore, future work could consider investigating the quality issues that arise in specific project types, in order to offer even greater insight for those quality managers engaged in such projects.
- This study did not consider the impact of culture as a critical success factor, as it did not emerge from the literature as an important factor to consider in the construction industry context, nor was it raised in the interviews with the project managers. Nevertheless, with the aforementioned need to consider how the critical success factors may change over time due to shifts in the organisational landscape, there may be scope to explore the impact of culture in future study as a potential critical success factor.

7.10 Final words

This chapter presented a summary of the four objectives underpinning this study, alongside evidence of how each was achieved. After that, the research findings were presented, with the detailed outcomes of each of the ten initial critical success factors presented. Then, the methodology was critiqued, followed by the study's limitations, the research novelty, the study's recommendations and a chapter conclusion. Notwithstanding the limitations highlighted in section 6.6, the researcher has confidence in the results of this study, whereby those critical success factors and their associated factor components that were found to be vital for the successful implementation of the ISO 9001 QMS in UK construction projects have been identified. Although the data interpretation has now been concluded, further refining of the findings and their significance may be carried out in future. To date, two journal articles have been drafted and submitted to peer-reviewed academic journals, while one article has been presented at a conference. This will serve to enable the dissemination of the findings from this research. Moreover, presentations at seminars and further journal publications will be considered in future.

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Appendices

Appendix 1: The Quality Management Survey

Survey to Determine the Critical Success Factors to Support the ISO 9001 Quality Management System's Implementation in Construction Projects

1. Does your organisation have ISO 9001 QMS certification?

☐ Yes ☐ No

If NO, please explain why: ____

2. Does your organisation apply the ISO 9001 QMS standard in its construction projects?

☐ Yes ☐ No

Please explain why: ____

3. If your organisation does not apply the ISO 9001 QMS standard in its construction projects, does it adopt another QMS to manage quality?

☐ Yes ☐ No

4. *Please select the extent that you agree or disagree with the following statements by circling one number per row.*

For decision-making during the lifecycle of a construction project, it is important that I/ my organisation undertake the following activities:

	Strongly agree		*Neither agree / disagree*		*Strongly disagree*
Analyse data through appropriate methods	**5**	**4**	**3**	**2**	**1**
Use the analysis of process data to inform decisions	**5**	**4**	**3**	**2**	**1**
Evaluate the effectiveness of actions taken to address risks	**5**	**4**	**3**	**2**	**1**
Evaluate the effectiveness of actions taken to address opportunities	**5**	**4**	**3**	**2**	**1**
Monitor performance	**5**	**4**	**3**	**2**	**1**
Measure performance	**5**	**4**	**3**	**2**	**1**
Analyse performance	**5**	**4**	**3**	**2**	**1**
Conduct internal audits	**5**	**4**	**3**	**2**	**1**
Evaluate individual performance	**5**	**4**	**3**	**2**	**1**
Ensure access to reliable data	**5**	**4**	**3**	**2**	**1**
Strike a balance between practical experience and data analysis	**5**	**4**	**3**	**2**	**1**

Other (please specify): ____

5. ***Please select the extent that you agree or disagree with the following statements by circling one number per row.***

To address client focus in construction projects, it is important that I/ my organisation undertake the following activities:

	Strongly agree		***Neither agree / disagree***		***Strongly disagree***
Understand current clients' requirements	**5**	**4**	**3**	**2**	**1**
Understand future clients' requirements	**5**	**4**	**3**	**2**	**1**
Measure client satisfaction	**5**	**4**	**3**	**2**	**1**
Exceed client expectations	**5**	**4**	**3**	**2**	**1**
Focus on the intangible advantages to increased client satisfaction	**5**	**4**	**3**	**2**	**1**
Ensure the project objectives match the client's requirements	**5**	**4**	**3**	**2**	**1**
Ensure the project objectives match the client's expectations	**5**	**4**	**3**	**2**	**1**

Other (please specify): ____

6. ***Please select the extent that you agree or disagree with the following statements by circling one number per row.***

To reduce the impact of non-standardisation during the construction project lifecycle, it is important that I/ my organisation undertake the following:

	Strongly agree		***Neither agree / disagree***		***Strongly disagree***
Develop quality system documentation	**5**	**4**	**3**	**2**	**1**
Enhance quality system documentation	**5**	**4**	**3**	**2**	**1**
Improve the efficiency of processes through documentation	**5**	**4**	**3**	**2**	**1**

Other (please specify): ____

7. ***Please select the extent that you agree or disagree with the following statements by circling one number per row.***

To engage the project team in construction projects, it is important that I/ my organisation undertake the following activities:

	Strongly agree		***Neither agree / disagree***		***Strongly disagree***
Facilitate open discussion of issues	**5**	**4**	**3**	**2**	**1**
Facilitate open discussion of barriers	**5**	**4**	**3**	**2**	**1**
Enhance motivation of personnel	**5**	**4**	**3**	**2**	**1**
Promote quality issues through efficient teamwork	**5**	**4**	**3**	**2**	**1**
Increase employee satisfaction	**5**	**4**	**3**	**2**	**1**
Ensure that employees' abilities are utilised	**5**	**4**	**3**	**2**	**1**
Ensure that employees' abilities are valued	**5**	**4**	**3**	**2**	**1**

Other (please specify): ____

8. ***Please select the extent that you agree or disagree with the following statements by circling one number per row.***

To promote construction project leadership, it is important that I/ my organisation undertake the following activities:

	Strongly agree		***Neither agree / disagree***		***Strongly disagree***
Establish a vision for the project	**5**	**4**	**3**	**2**	**1**
Establish a pathway for the project	**5**	**4**	**3**	**2**	**1**
Empower employees	**5**	**4**	**3**	**2**	**1**
Equip employees	**5**	**4**	**3**	**2**	**1**
Create trust with employees	**5**	**4**	**3**	**2**	**1**
Ensure commitment to the role	**5**	**4**	**3**	**2**	**1**
Ensure commitment to policy	**5**	**4**	**3**	**2**	**1**
Ensure responsibility to project partners	**5**	**4**	**3**	**2**	**1**
Reduce the environmental impact	**5**	**4**	**3**	**2**	**1**
Identify challenging targets	**5**	**4**	**3**	**2**	**1**
Promote high-quality processes	**5**	**4**	**3**	**2**	**1**
Ensure the efficient use of resources	**5**	**4**	**3**	**2**	**1**
Other (please specify): ____					

9. ***Please select the extent that you agree or disagree with the following statements by circling one number per row.***

To promote a process approach during the lifecycle of the construction project, it is important that I/ my organisation undertake the following activities:

	Strongly agree		***Neither agree / disagree***		***Strongly disagree***
Manage activities as processes	**5**	**4**	**3**	**2**	**1**
Reduce activities that add no value	**5**	**4**	**3**	**2**	**1**
Reduce processes that add no value	**5**	**4**	**3**	**2**	**1**
Conduct audits of processes	**5**	**4**	**3**	**2**	**1**
Improve processes to prevent nonconformities	**5**	**4**	**3**	**2**	**1**
Determine the knowledge necessary for the operation of processes	**5**	**4**	**3**	**2**	**1**
Maintain the knowledge necessary for the operation of processes	**5**	**4**	**3**	**2**	**1**
Take action to address risk	**5**	**4**	**3**	**2**	**1**
Take action to exploit opportunity	**5**	**4**	**3**	**2**	**1**
Gauge the feasibility of activities	**5**	**4**	**3**	**2**	**1**
Determine links between activities	**5**	**4**	**3**	**2**	**1**

Other (please specify): ____

10. ***Please select the extent that you agree or disagree with the following statements by circling one number per row.***

To manage relationships with stakeholders during the lifecycle of a construction project, it is important that I/ my organisation undertake the following activities:

	Strongly agree		***Neither agree / disagree***		***Strongly disagree***
Share information with stakeholders	**5**	**4**	**3**	**2**	**1**
Share plans with stakeholders	**5**	**4**	**3**	**2**	**1**
Share resources with stakeholders	**5**	**4**	**3**	**2**	**1**
Share expertise with stakeholders	**5**	**4**	**3**	**2**	**1**
Cooperate in the development of activities	**5**	**4**	**3**	**2**	**1**
Establish effective intra-project-partner cooperation	**5**	**4**	**3**	**2**	**1**
Manage effective intra-project-partner cooperation	**5**	**4**	**3**	**2**	**1**
Establish short-term relationships	**5**	**4**	**3**	**2**	**1**
Establish long-term relationships	**5**	**4**	**3**	**2**	**1**

Other (please specify): ____

11. ***Please select the extent that you agree or disagree with the following statements by circling one number per row.***

In relation to skills and training, it is important that I/ my organisation undertake the following activities:

	Strongly agree		***Neither agree / disagree***		***Strongly disagree***
Train personnel in terms of quality	**5**	**4**	**3**	**2**	**1**
Share knowledge	**5**	**4**	**3**	**2**	**1**
Enable learning	**5**	**4**	**3**	**2**	**1**
Share the quality aims and characteristics	**5**	**4**	**3**	**2**	**1**
Teach the quality aims and characteristics	**5**	**4**	**3**	**2**	**1**
Manage communication	**5**	**4**	**3**	**2**	**1**
Improve communication	**5**	**4**	**3**	**2**	**1**

Other (please specify): ____

12. ***Please select the extent that you agree or disagree with the following statements by circling one number per row.***

To apply continuous improvement during the construction project lifecycle, it is important that I/ my organisation undertake the following activities:

	Strongly agree		***Neither agree / disagree***		***Strongly disagree***
Provide resources for continuous improvement	**5**	**4**	**3**	**2**	**1**
Manage resources for continuous improvement	**5**	**4**	**3**	**2**	**1**
Provide documentation for corrective action	**5**	**4**	**3**	**2**	**1**
Enable the project team to participate in improvement	**5**	**4**	**3**	**2**	**1**

Conduct operational planning	**5**	**4**	**3**	**2**	**1**
Conduct operational control	**5**	**4**	**3**	**2**	**1**
Identify the requirements	**5**	**4**	**3**	**2**	**1**
Measure improvement consistently	**5**	**4**	**3**	**2**	**1**
Analyse performance	**5**	**4**	**3**	**2**	**1**
Celebrate improvement	**5**	**4**	**3**	**2**	**1**
Develop a reward system	**5**	**4**	**3**	**2**	**1**
Other (please specify): ______________________________					

13. ***Please select the extent that you agree or disagree with the following statements by circling one number per row.***

To manage change during the construction project lifecycle, it is important that I/ my organisation undertake the following activities:

	Strongly agree		***Neither agree / disagree***		***Strongly disagree***
Determine the needs and expectations of stakeholders	**5**	**4**	**3**	**2**	**1**
Monitor the needs and expectations of stakeholders	**5**	**4**	**3**	**2**	**1**
Promote continual improvement	**5**	**4**	**3**	**2**	**1**
Plan for change	**5**	**4**	**3**	**2**	**1**
Other (please specify): ______________________________					

Appendix 2: Cover Letter for the Quality Management Survey

Dear …………......

I am a Doctoral research student at the School of Science, Engineering and Environment at the University of Salford. The focus of my research is identifying the critical success factors that support the implementation of the ISO 9001 quality management system in UK construction projects.

I sincerely hope that you might assist me in this research by completing a short survey, which aims to investigate the critical success factors for effective ISO 9001 quality management survey (QMS) implementation in UK construction projects through the perceptions of UK construction project managers; the survey will take around 10 minutes to complete, and the target group is UK construction project managers.

I would like to take this opportunity to assure you that this survey does not ask for individual or organisational information, and therefore cannot be attributed back to yourself or your company. The data will be anonymised and given a research code, known only to the researcher, and will not be reproduced or communicated with any third party.

The data will be published only as part of this study, and the results will be made available to you on request by email. All data will be stored securely, will be password-encrypted and will remain strictly confidential at all times.

I await your reply and thank you for your kind assistance.

Sincerely,

Researcher's name: Mahmoud Aburas

Email: M.Aburas@edu.salford.ac.uk

Appendix 3: Ethical Approval for the Study

Research, Innovation and Academic Engagement Ethical Approval Panel

Doctoral & Research Support
Research and Knowledge Exchange,
Room 827, Maxwell Building
University of Salford
Manchester
M5 4WT

T +44(0)161 295 5278

www.salford.ac.uk/

2 April 2019

Mahmoud Aburas

Dear Mahmoud

RE: ETHICS APPLICATION STR1819-35 – A UK Study on the Development of a Quality Management Framework to support Implementation in Construction Projects in Accordance with ISO 9001:2015

Based on the information you provided, I am pleased to inform you that your application STR1819-35 has been approved.

If there are any changes to the project and/ or its methodology, please inform the Panel as soon as possible by contacting S&T-ResearchEthics@salford.ac.uk

Yours sincerely,

Dr Devi Prasad Tumula
Deputy Chair of the Science & Technology Research Ethics Panel

Appendix 4: The Validation Interview Questions

1- How many years' experience do you have in the construction sector?

2- Which field or sector does your company work in?

3- Do you use the ISO 9001 QMS in your construction project?

4- Do you face any problems when you implement the ISO 9001 QMS in your project?

5- Are there any apparent benefits when you use the ISO 9001 QMS in your construction project?

6- Client Focus: The other project managers in the questionnaire believed that client focus is one of the critical success factors for effective implementation of the ISO 9001 QMS in UK construction projects and for a successful project.

   Do you agree? Why?

7- Engagement of People: The other project managers in the questionnaire believed that the engagement of people is one of the critical success factors for effective implementation of the ISO 9001 QMS in UK construction projects and for a successful project.

   Do you agree? Why?

8- Leadership: The other project managers in the questionnaire believed that leadership is one of the critical success factors for effective implementation of the ISO 9001 QMS in UK construction projects and for a successful project.

   Do you agree? Why?

9- Process Approach: The other project managers in the questionnaire believed that the process approach is one of the critical success factors for effective implementation of the ISO 9001 QMS in UK construction projects and for a successful project.

Do you agree? Why?

10- Continuous Improvement: The other project managers in the questionnaire believed that continuous improvement is one of the critical success factors for effective implementation of the ISO 9001 QMS in UK construction projects and for a successful project.

Do you agree? Why?

11- Change Management: The other project managers in the questionnaire believed that change management is one of the critical success factors for effective implementation of the ISO 9001 QMS in UK construction projects and for a successful project.

Do you agree? Why?

12- Relationship Management: The other project managers in the questionnaire believed that relationship management is one of the critical success factors for effective implementation of the ISO 9001 QMS in UK construction projects and for a successful project. Do you agree? Why?

13- Skills and Training: The questionnaire findings rejected skills and training as one of the critical success factors for effective implementation of the ISO 9001 QMS in UK construction projects and for a successful project.

Do you agree? Why?

14- Non-Standardisation: The questionnaire findings rejected non-standardisation as one of the critical success factors for effective implementation of the ISO 9001 QMS in UK construction projects and for a successful project.

Do you agree? Why?

15- Evidence-Based Decision-Making: The questionnaire findings rejected evidence-based decision-making as one of the critical success factors for effective implementation of the ISO 9001 QMS in UK construction projects and for a successful project.

Do you agree? Why?

Appendix 5: Information Sheet for the Validation Interviewees

Dear Interview Participant,

I am a doctoral research student at the School of Science, Engineering and Environment at the University of Salford. The focus of my research is identifying the critical success factors that support the implementation of the ISO 9001 quality management system in UK construction projects.

I sincerely hope that you might assist me in this research by participating in a short interview (30–60 minutes), which aims to validate the critical success factors that support ISO 9001 quality management system (QMS) implementation in construction projects.

The interview will not ask for individual or organisational information. If possible, the interview will be audio recorded to allow your responses to be analysed in greater depth. This recording will be kept secure, only be accessible to the researcher, and will be destroyed on completion of the study. The interview data will be anonymised and given a research code known only to the researcher, and will not be reproduced or communicated with any third party. If you prefer not to have the interview audio recorded, then please indicate this before the interview starts and I will take notes instead.

The data will be published only as part of this study, and the results made available to you on request. All data will be password-encrypted and will remain strictly confidential at all times.

I thank you for your kind assistance.

Sincerely,

Mahmoud Aburas (Researcher)

Email: M.Aburas@edu.salford.ac.uk